Issued Bi-Monthly

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The magazine for Sinclair users

sync

®

In-depth Evaluations:
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- Printers
- Software
- Books

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- Hardware
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Make the Most of Your ZX81

The Sinclair ZX-81 is innovative and powerful. Now there's a magazine to help you get the most out of it.

GET IN SYNC

Thousands of smart consumers have picked the Sinclair ZX-81 as their personal computer. And, unlike many of today's bargains, this one can really give you your money's worth. Or it can turn into nothing but an expensive calculator. A Sinclair owner can putter along in first gear, missing the power and potential of the ZX-81, or he can shift into high, pushing the ZX-81 beyond imaginable limits. That's why thousands of smart consumers have picked **SYNC** as their computer magazine.

Right on Target

The ZX-81 is unique. There is nothing like it, nothing that comes close to packing so much power and versatility into one small package. Some computer magazines might publish one or two articles about the Sinclair each year, some never mention it. **SYNC** covers only the ZX-81 and its predecessor, the ZX-80. If an article doesn't apply to the Sinclair, if a game doesn't work on the Sinclair, you won't see it in **SYNC**. Our staff and contributors are Sinclair owners. Some started out as experts. Others started as readers and became experts.

How can a whole magazine find enough material about one small computer? By covering everything from hardware to software, by offering both new applications and old tricks with a new twist. Did you know that the Sinclair can generate music? Our readers found that out when we published a program and article showing how to do it, and explaining why it works. Do you know where to buy software, books, or peripherals for the ZX-81? We list resources in every issue, along with addresses for user's groups so you can get in touch with other Sinclair owners. But knowing where to buy is not enough by a long shot. And that's where we can really help you out.

Hard-Hitting Evaluations

As a Sinclair owner, you know the value of a dollar. But it isn't always easy to know the value of all the extras on the market. Face it, some programs are great, some aren't worth the tape they're stored on. We receive every new product for the Sinclair as soon as it is available, often months before it is on the market. And those products are reviewed and tested with a very critical eye. If an advertiser doesn't care for this sort of honesty, we don't care for his business. We haven't gotten where we are by patting backs, we've gotten there by giving the Sinclair owner the information he needs. But there's more to **SYNC** than just reviews.

Applications and Explanations

The ZX-81 comes with a very powerful Basic language. But power doesn't imply difficulty. We show you how to get the most from your computer, whether you want to write a game or keep track of a mailing list. And we don't stop with Basic. The Sinclair can be programmed in machine language. For the newcomer, we have articles explaining machine language from the ground up. For the old pro (and anyone who has been reading **SYNC** for a while will soon find himself in this category) we have sophisticated routines for animation, data handling, and every other aspect of programming.

Don't run your computer in first gear.

Topping if off, hardware articles cover everything from attaching a full-size keyboard to adding a tape monitor. Whether you are interested in software or soldering, we'll keep you busy. But we also know how to have fun.

Games of Every Kind

If you like to shoot down attacking spaceships, fight monsters in a dungeon, or land on the moon, we've got what you want. Every issue of **SYNC** is packed with games. There are classic computer games converted for the Sinclair, and new games designed specifically to exploit the capabilities of the ZX-81. Our contributors keep getting better and better, but that's not surprising, because the games come complete with tips and explanations. Programming tricks and special techniques are fully explained, so you can use them in your own games. We don't believe in keeping secrets.

SYNC is a Creative Computing publication. **Creative Computing** is the number 1 magazine of software and applications with over 150,000 circulation. The two most popular computer games books in the world, *Basic Computer Games* and *More Basic Computer Games* (combined sales over 500,000) are published by Creative Computing. Creative Computing Software manufactures over 150 software packages for six different personal computers.

Order SYNC Today and Save Money!

When you order an introductory subscription to **SYNC**, you'll save a substantial amount of money. One year (6 issues) costs just $12.97—19% off. Two years go for $22.97 (28% off), and three years for $31.97 (33% off). All savings are based on the full one-year subscription price of $16. Whichever term you prefer, use the attached postpaid card to order. Or make your check payable to **SYNC** and mail it to the address below.

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Please allow 60 to 90 days for delivery of your first issue. We guarantee your satisfaction or we will refund the full amount for all the unmailed issues remaining in your subscription.

Needless to say, we can't fill up all the pages without your help. So send in your programs, articles, hints and tips. Remember, illustrations and screen photos make a piece much more interesting. Send in your reviews of peripherals and software too—but be warned: reviews must be in-depth and objective. We want you to respect what you read on the pages of **SYNC** so be honest and forthright in the material you send us. Of course we pay for contributions—just don't expect to retire on it.

The exploration has begun. Join us.

The magazine for Sinclair users

SYNC

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Remembering numbers is genie work.

Busy Buttons

Turn those innocent little buttons on your telephone into Busy Buttons and release the genie from its little black box.

A fairy tale? The story you are about to read may be true or it may be false.

If the story is false, we've wasted a lot of your time. If the story is true, well...you might just make a lucky discovery. Here's why.

Your push button telephone has a bunch of buttons that make beeping sounds when you press them. The beeping sounds send signals or actually 'talk' to your phone company and its computerized switching system. That's how calls are made.

Now think of it. What if your phone was first connected to your own telephone computer. And what if in your own telephone computer you had a real genie that actually took your command and performed electronic magic on your phone lines. Far fetched? Read on.

WHAT KIND OF MAGIC

What if the system proved to be the fastest and most positive way to reach another person at another phone regardless of whether the phone is busy or whether that person is even near a phone. Enter Busy Buttons.

Busy Buttons is a miniature computer in a small black box. The box is nothing much to look at, measures only 1½" x 5" x 5¾" and in fact most people would probably hide it. The box plugs into the back of any telephone in your house or any multi-line telephone in your office. That's right, just plug it in. No installation, no wires to connect. Just plug it in.

HERE IT COMES

Now here comes the fairytale part. In that black box is indeed a real genie–a small creature so smart that it will understand every command you give it from your telephone's push buttons. No foolin'.

If you dial a number and that number is busy, you tell the genie you're upset by pressing the 'frustration' button–that's the button with a star on it. The genie will first redial that same number ten consecutive times the first minute and then once every two minutes thereafter until it reaches your party. When the call does go through, your genie will then signal you to pick up the phone. And you can still make calls and receive calls in between those times your genie is trying to reach the other party.

But what if there's no answer? After you let your phone ring for awhile, press the 'disappointment' button. The genie will then dial your number every ten minutes for up to ten hours and then signal you when somebody answers.

GENIES NEVER FORGET

"But what if the genie forgets the number it was dialing?" you might ask. The answer is quite logical. Genies never forget. In fact, you can own a genie so smart it will remember up to 176 numbers each up to 32 digits so you can not only dial long distance, you can use your genie to dial the entire 23 digit MCI or Sprint numbers in seconds. Your genie will recognize the tones, the pauses and faithfully dial your number accurately each time saving you tons of money on long distance charges.

"Too complicated," you might say. For your genie it might be but not for you. Remember, you use your own push button phone. There's no other attachment other than that dumb black box where your genie lives. And when you want to dial a number, you dial PAUL to reach Paul, MOM to reach your mom or HAIR to call your hair stylist. Remembering names is easy, remembering numbers is genie work.

THE REAL SHOCK

Ready for a real shock? You only need one genie to cover every telephone in your house or office. That's right. Unlike other auto dialers, one genie is all you need to turn every phone into this fully automatic system. But wait, there's more.

Genies talk differently. The American genie talks very rapidly in tones like most push button phones. There is even a Japanese genie that talks slowly and methodically in a pulsating sound similar to a rotary dial telephone. This means you can use Busy Buttons on push button or rotary dial telephones.

The Busy Button system is quite inexpensive. Genies you see have no minimum wage, are exempt from EEOC, EPA, OSHA, FDA and HEW regulations and don't mind putting in overtime or washing windows.

DIFFERENT VERSIONS

A 176 number Busy Buttons costs only **$200**–the 93 number version costs **$180**. If you want the Japanese Genie, you can have either model for $20 cheaper. And you can order Busy Buttons using your credit card by calling our toll-free number below. (Illinois residents add 6% sales tax.) Or send your check for the amounts listed above plus $4.00 for postage and handling to the address below.

When you receive your Busy Buttons computer just plug it in. That's right, plug it in. Then see how easy it is to program, how easy it is to redial a number either yourself or automatically. If you're not happy with the convenience of the Busy Buttons or the time and money you save from the day you install it, return it anytime within 30 days for a prompt and courteous refund including your $4.00 postage and handling charge. It won't cost you a penny and you won't insult the genie.

At the beginning of this advertisement we told you that the above story may be true or it may be false. Well it's true. There really is a genie in every Busy Buttons. And if you believe that, wait till you hear about our new computerized burglar alarm with its own built-in SWAT team. Order your Busy Buttons at no obligation, today.

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ZX81 SOFTWARE: A TO ZZZAPPP!!

WALLBUSTERS, CHESS, SUPER INVASION, ADVENTURE AND MORE...

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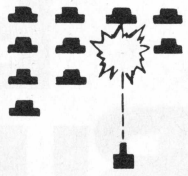


"The best Sinclair game to hit the market." —SYNC Magazine. A moving graphics game with three levels of play. SUPER INVASION challenges your skill as you fire lasers at the attacking space invaders while maneuvering your space craft to avoid their deadly lasers.

1K $14.95

WALLBUSTERS

"A breakthrough in creating active display games."-SYNC Magazine. WALLBUSTERS challenges you to break through two barricades using nine balls and a curved bat. With seven levels of play, WALLBUSTERS is hard to beat. You'll be amazed at the superb graphics in this 1K game.

1K $14.95

ZXCHESS

This sophisticated chess game has seven levels of play and a detailed display of the board. You can change sides and even change levels of difficulty during a game. You can also start playing from any point in the game and if you get stuck, the computer will recommend a move.

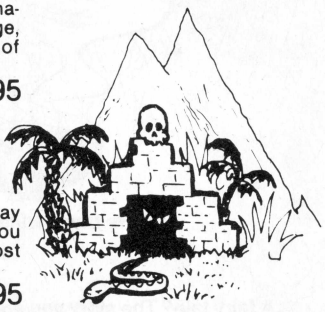
16K $24.95

ADVENTURE "A"

Your space ship is marooned on a strange planet but you can get out if you make the right combination of decisions. Written in machine language, this challenging adventure has over 100 words of vocabulary.

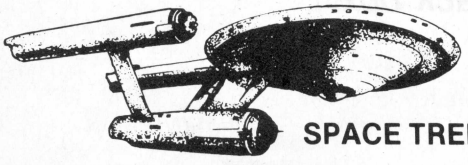
16K $19.95

ADVENTURE "B"



Enter the long lost Inca Temple, find your way through the tricky tunnels and corridors and you may find the lost treasure. Or you may be lost forever.

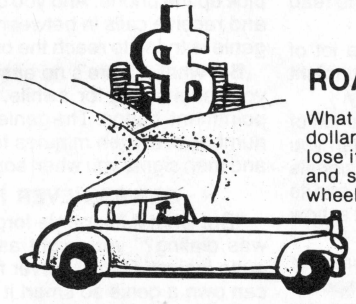
16K $19.95



SPACE TREK

As commander of Starship Enterprise, you find yourself defending a galaxy overrun with the dreaded DRAKONS. Can you destroy them? With five levels of play and excellent graphics, you'll find SPACE TREK entertaining and challenging. Can only be used with the ZX81.

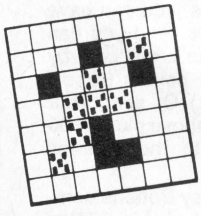
16K $14.95



ROAD TO RICHES

What would you do if someone gave you a million dollars to invest? Would you make more money or lose it all? This investment game combines luck and strategy to challenge up to four players to wheel and deal their way to riches...or ruin.

16K $14.95



REVERSI

if you like Othello, you'll love REVERSI. With the board displayed, you can go first or let the computer go and you have a choice of starting positions.

1K $14.95

TEN EXCITING PROGRAMS FOR THE ZX81: 1K

These BASIC programs on cassette include Lunar Lander, Space War and Brands Hatch. Included are complete listings and suggestions so you can learn and adapt programs. Can only be used with the ZX81.

1K $14.95

DIRECTORY/RECORD

Two programs on one cassette with full listings. The DIRECTORY program allows you to read names of programs saved on cassette. The RECORD program allows you to save and load 96 Byte data records on tape and can be incorporated into other programs.

1K $14.95

MACHINE LANGUAGE PROGRAMMING

Made Simple For the Sinclair ZX81. This book is a complete guide in machine language for the beginner.

BOOK $19.95

UNDERSTANDING YOUR ZX81 ROM

This book gives an overview of machine language and describes the operation of the Sinclair ROM. Essential for the serious programmer.

BOOK $19.95

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The magazine for Sinclair users

SYNC

SYNC Special Issue

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A

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PUBLICATION

sync notes

Paul Grosjean

Greetings to New Readers

This special issue of *SYNC* is being published to introduce you, as a new owner of a Sinclair ZX81 computer, to our magazine and to invite you to become a subscriber.

SYNC is the only magazine devoting its entire content to the Sinclair computer series. It is one of four magazines published by Creative Computing (the others are *Creative Computing, Microsystems*, and *Small Business Computers*). *SYNC* is published bi-monthly about the middle of the cover date period (that is, the Jan/Feb issue would be published at the end of January). Each issue has 48 pages of articles, features, departments, and ads to help you get the most out of your computer in learning and enjoyment. Nearly all our content comes from Sinclair users who have written up the results of their study, work, and play with the Sinclair computers for their fellow users.

As a result, we have a wide variety of articles which will help you to solve practical problems with your computer, to write programs, to build hardware, to develop software, to make informed choices of products through our reviews, and to have fun through games. We try to have articles that will be useful to beginners and to those further along the way. Learning involves some work, but it can also be fun. The great challenge is to make your computer do what you want it to do, and success in meeting that challenge gives great satisfaction. Then, when you have learned something new from *SYNC*, we hope that you will use it to do more with your computer and that you will write that up for other *SYNC* readers.

This special issue of *SYNC* is just like a regular issue except that it is not quite as long. We have selected articles from past issues of *SYNC* which we feel will not only give you a sample of *SYNC* but also be immediately useful to you as a new ZX81 owner.

In addition to articles, we have a number of departments:

Letters to the Editor. We regret that we cannot answer individual letters, but we will print letters which we feel will be of interest to our readers. Questions raised in letters will be referred to some of our authors who are willing to answer questions in their fields. If you send us a letter for publication, address it "Letters to the Editor" and keep in mind that it should be typed doubled spaced on one side of a sheet of paper if at all possible. We prefer letters that are short and to the point.

Glitchoidz Report. In this column we print program errors which affect the running of the program. If you find any, you can send a card or letter addressed to "Glitchoidz Report." Do not include here suggestions for program improvements; these go to "Letters."

Perceptions is a regular column written by David Ornstein. David deals not only with the hardware but also the software side of your computer. Topic suggestions are welcome.

Kitchen SYNC is regular column written by Alan Groupe, Michael Tardiff, and Ivan Zatkovich. They work with the big computers all day and have taken a "vow" to apply their backgrounds to exploring the basic 1K RAM Sinclair computer to see how far it can be pushed. They also welcome topic suggestions.

Try This is a short column for short programs to amaze, mystify, and impress your friends. Contributions should be addressed to the column.

The World of Compukid is a cartoon series looking at the world through the eyes of the young people who are growing up in a world of personal computers. Ideas are welcome.

Resouces is a page on which new products are reported. We list the product, a brief description, ordering information, and the address. If you find a product we have not yet listed, either send us the information addressed "Resources" or tell your supplier about *SYNC* so that he can contact us directly. There is no charge for a one time listing.

Finally you will be able to keep up with the flow of products and services available to Sinclair users from our advertisers. If you know of a supplier who has not advertised with us or if you yourself have a product or service, we will be glad to send information regarding advertising in *SYNC* and the other Creative Computing publications.

All correspondence should be sent to:
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SYNC Program Listings

Readers should note the following conventions used in the program listings in this issue:

or • = Used in PRINT statements to show necessary spaces.

"*A*" (shift) = Used in PRINT statements to indicate graphics; in this case use the graphic on shift A.

INPUT = Used in PRINT statements to show that the keyboard key or token should be used instead of spelling out the word (Richard McDaniel's article in this issue).

Writing for SYNC

If you have material you want us to consider for publication, we are very much interested in looking at it. If it fits our editorial needs at that time, we will send you a "Transfer of Copyright Agreement" to sign and payment for your article. On the average we pay about $20 per printed page in *SYNC*. When you submit material, we ask that you keep the following in mind:

1) Type your manuscript on standard typing paper (one side only) with at least one inch margins all around.

2) Use the double space setting for your text throughout.

3) If you want your manuscript returned, enclose a self-addressed stamped (do not use a postage meter) envelope. If you want to be sure that we have received your work, enclose a self-addressed postcard.

4) Be sure to put your name, address, and phone number on the top of the first page in one corner. In the other corner put the machine requirements of your article or program (for example, 8K ROM; 1K RAM. 8K ROM; 16K RAM. 4K ROM; 1K RAM). Remember that our readers have a variety of ROMs and RAMs and they are not happy to find out after they have entered a program that it does not fit their machine. Put the title or a short form of the title on each page in the upper left corner. Paginate on the upper right corner.

3) Show necessary spaces in PRINT statements with a # mark.

4) Program notes which help the reader to understand what is going on are helpful.

SYNTAX ZX80®

A PUBLICATION OF **THE HARVARD GROUP**

SYNTAX ZX80 is a monthly newsletter exclusively for ZX80, ZX81 and MicroAce owners. We bring you news, reviews and applications for your computer, plus technical notes for circuit-builders. SYNTAX also provides a forum for thousands of users to share advice and problems about programs and vendors. We bring you timely updates about new hardware, software and books. And we cover *all* the Sinclair-MicroAce computers, including the new ZX81.

At SYNTAX we emphasize practicality. You can apply our suggestions even if you aren't sure at first why they work, because we give you complete instructions. Text is clear and easy to understand. SYNTAX readers already know about:

- An automatic phone-dialer they can put together in a few hours
- Syntactic Sums™ to check input for errors
- Printing characters four times normal size
- Programs to explore computer memory
- Cassette eavesdropping to locate files on tape and simplify loading
- How to build their own external additional RAM
- How to add an 8212 I/O chip to control external devices from their computers

And SYNTAX readers like what they get every month. Subscribers know they can depend on us.

After receiving only three issues of SYNTAX ZX80, I find that I anxiously await the next issue . . . keep up the good work!

Martin Irons
Goshen, NY

Congratulations on the brass-tacks, down-to-earth approach of your newsletter. I'll be looking forward to future issues.

Otis Imboden
Washington, DC

Many readers get their first issue and immediately order the back issues — more proof that they like what they see.

What's special about our publication? Just look through one issue. We work hard to bring you a quality newsletter. We strive to print useful programs of above-average accuracy. As any computer magazine editor can tell you, program listing accuracy is tough to achieve, but we boost our average with every issue. We test each program to make sure it works, it fits in the designated RAM, and it runs when you follow the directions. We print program listings in screen-image format to make it easier for you (it's sure not easier for us!) to enter programs accurately. We invented Syntactic Sum™ as an additional aid for you in getting error-free programs. With your subscription you also get access to thousands of other readers, and our staff experts are available by phone to answer your questions or help you solve problems with your machine.

SYNTAX readers get every month:

- Latest news of Z80 hardware and software
- Programs to organize information, calculate, entertain, or instruct
- Do-it-yourself additions to the ZX80/MicroAce/ZX81
- Clear explanations for beginners

To share the benefits of SYNTAX ZX80, just complete the coupon below and return it with your choice of payment. You will receive a year's subscription, 12 issues, for only $29 in US funds (plus $14 for foreign airmail if you live outside North America).

We are so sure you'll find SYNTAX useful that we promise to refund your entire subscription fee if you aren't satisfied. An unconditional guarantee — you can't lose. But if you're still skeptical, send $1 for a sample issue and see for yourself how SYNTAX can help you use and enjoy your ZX80 or ZX81 more.

Join the others who stretch their ZX80s and ZX81s to the utmost. Act now — as soon as we receive your coupon with payment, your first issue will be on its way. For faster service, phone your credit card order to 617/456-3661. Don't miss SYNTAX!

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S182S

These may be given as side notes on the same line as the program line or at the end of the program with line numbers for matching. In either case keep the width of the notes the same as the program listing.

5) If you use graphics, be sure to specify in the notes which key to use to get the graphic.

6) If possible, make suggestions for adapting your program to fit other machine requirements. For example, if you have a program that takes 2K RAM, tell the reader where to shorten it to squeeze it into 1K if possible. If you are writing for an 8K ROM, supply the changes necessary for the 4K ROM if possible. Readers like to know where they can make changes in the programs to vary the results. Point these out also.

7) Type your program single spaced.

8) Be sure to indicate in your article how to RUN the program and what the reader should expect to see on the screen when he has done so.

9) Follow the emerging conventions for ZX80/81 programs: a) number program lines by 10's unless you have a reason to do otherwise; b) avoid using letters that can be confused with numbers and vice versa; c) use consecutive designations for strings and variables; d) identify your program with a REM statement.

10) Provide the SYNCSUM (see the Perceptions column in this issue). Other checksums may be used if there is a good reason to do so, but the process for finding them should be explained.

Photos, illustrations, charts, and diagrams usually add to an article. Again, we prefer copy that we can use directly without redrawing. Illustrations can be larger than the expected final form because we can reduce them, but they should not be smaller. All charts, diagrams, listings, illustrations, photos, tables, and programs should be labeled such as Figure 1, Listing 1, or Table 1 and referred to in the text in that way rather than as "the table below" or "the following lines" because we may not be able to do it that way in our layout. It is even helpful to put all the figures, tables, etc. at the end of your article.

If you can supply your text and program listings on disk, include the information on the type of disk system you have. We would prefer that form if it is compatible with our equipment.

Following these suggestions will help us a great deal in using your material.

5) Type with normal use of capital and lower case letters. Do not type everything in capitals in your text (in programs, however, do use capitals since that is what your computer uses). This applies also to headings and subheadings. Show subheadings by leaving extra space above and centering.

6) Underlining means that those letters should be italics when printed. So underline only when you mean "Use italics here."

7) Paragraphs must be indented (5-8 spaces is usual). *Do not* use extra lines to show paragraphs.

If your article includes programs or listings, please keep these items in mind:

1) We prefer camera ready copy of programs and listings whenever possible because this substantially reduces the risk of typographical errors. Carbon ribbon typewriters make excellent copy. Printers and regular typewriters which give a sharp, clear image usually can be used, but make sure that the ribbon is dark. Of course, when the ZX Printer becomes available in the U.S., printouts from it will be acceptable. In addition, we would like to have the programs submitted on cassette with several saves, especially if the program is over 1K.

2) Type the program so that it will look just like the screen display including all spaces that are necessary or that the computer puts in automatically. Do not use extra spaces where the computer does not use them. This is a big help to the reader in checking whether he is entering the program correctly and helps him reduce copying mistakes. ▪

try this

This columns will feature short programs to show off your computer, impress your family and friends, and tickle your imagination when *SYNC* arrives at your place. We invite your contributions. Address them to: Try This, SYNC, 39 E. Hanover Ave., Morris Plains, NJ 07950.

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10 REM YNC and hit NEWLINE
Type in:
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POKE 16517,147 and hit NEWLINE.
Then hit NEWLINE again.

With your computer in FAST mode, type in:
10 PRINT CHR$ (INT (RND*8)+2;
20 RUN
After observing the results, try it again in SLOW mode (hit SLOW and NEWLINE and then type RUN and NEWLINE). ▪

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"Expression Evaluators at Work" is the first of the Kitchen SYNC columns. Although the argument is presented in terms of the ZX80, the content applies equally to the ZX81.

Kitchen SYNC

Alan Groupe, Michael Tardiff, and Ivan Zatkovich

Expression Evaluators at Work

The three of us work for Digital Equipment Corporation, and, in the course of our work, we have unlimited access to a great number of large computers. Yet we each recently bought ZX80s. Why?

We were warned that the ZX80 was a relatively tiny computer, almost a toy, with limited capabilities and a "very small" amount of memory. But it was the restrictions and the limitations of the machine that interested us. The computers we use every day have millions of bytes of memory; operating systems occupy tens of thousands of bytes of memory; programs have all the RAM they need and more. There is comparatively little need to "economize" in writing software. When such a need arises, we talk of shrinking a 20K program to fit into 16K. We decided that it would be fun to see just how far a "little" machine could be pushed.

Since then, we have become impressed with some of the features this compact machine does offer, and we would like to share some of our observationss and discoveries with you.

One of the first unusual (to us) properties of the ZX80 version of Basic that we "discovered" is that anywhere you need to enter a number, you can enter an equation instead. Or, to put it more impressively, if less comprehensibly, the expression evaluator is called at each instance of a value-required context.

What does that mean, and why is it good?

If a computer language is to accept and solve equations, which we will call "expressions," it must have the ability to take an expression as input and return a numeric value as output. This portion of the language is called the "expression evaluator."

The expression evaluator first gets values for the variables in an expression and then performs the indicated arithmetic operations to end up with a single value. For example, enter the following commands into your ZX80 in the immediate mode (that is, without typing line numbers first).

```
LET A=5
LET B=3
LET X=A+B
PRINT X
```

You should have seen an "8" at the top of your screen. When you entered the third statement, the expression evaluator looked in memory and found the value of A (which was 5) and the value of B (set to 3 in the second LET statement), then added them together and filed the result under X.

While normally the expression evaluator is only used to handle arithmetic statements, like LET; on the Sinclair machine it is used anywhere a number can be entered. For example, in a GO TO statement, you could insert an expression in place of the statement number of the GO TO. Instead of:

```
GO TO 40
```

you could write

```
GO TO X+10
```

If X equals 30, the expression evaluator would first search out the value of X, add 30 and 10, and then "GO TO" the result: statement number 40.

In a machine like the ZX80, it is not much trouble for Basic to use the expression evaluator often, but it certainly can be very handy for us in writing programs.

For an example, enter and run the following small program:

```
10 INPUT LAST
20 PRINT LAST
30 GO TO 10
```

When you are prompted for input, enter the number 3. The number 3 will appear on the screen. Enter an 11 and an 11 appears. On lesser machines (like the TRS-80, etc.) this is all the program will do. But on the Sinclair, you have just written a simple calculator! Enter 3+9 and 12 appears on the screen. 4*7 gives you a 28. In fact, you can even use the previous answer in an expression (assuming you have typed in at least one expression previously). Enter LAST-5 and the Sinclair responds with 23 (assuming you been entering all the examples).

When you entered 3, the expression evaluator was used. It evaluated the expression and returned the result (3), which was stored in the variable LAST. When you entered 4*7, the expression evaluator evaluated the expression to 28 which was stored in LAST. And when you entered LAST-5, the expression evaluator recalled the value for LAST (28), subtracted 5 from it, and returned the result (23) which was stored in LAST.

Another posible use of this technique is in the following rather crude telephone directory:

```
 10 PRINT "ALAN GROUPE"
 20 PRINT "ALANS ADDRESS"
 30 PRINT "ALANS PHONE"
 40 STOP
 50 PRINT "MICHAEL TARDIFF"
 60 PRINT "MICHAELS ADDRESS"
 70 PRINT "MICHAELS PHONE"
 80 STOP
 90 PRINT "IVAN ZATKOVICH"
100 PRINT "IZZIES BAR AND GRILL"
110 PRINT "IVANS PHONE"
120 STOP
```

Running this program by entering "RUN" is of little value, since it will always print only the first person's information. So you must run the program with the GO TO command rather than the RUN command. If you want Alan's information, you enter GO TO 10. If you want Ivan's, you enter GO TO 90.

FOR ZX81 INFORMATION

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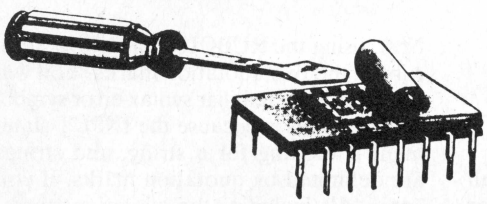

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This is all well and good, except that remembering the numbers is probably harder than remembering the addresses and phone numbers. However, after typing in the program, you can enter the following commands in immediate mode (that is, without typing line numbers first):

```
LET GROUPE=10
LET TARDIFF=50
LET ZATKOVICH=90
```

Now, if you want information on Ivan Zatkovich, you only need to enter GO TO ZATKOVICH. Again the expression evaluator is used. It determines that the variable ZATKOVICH has the value of 90 and then GOes TO statement 90. When you save a program on tape, the values of the variables are also saved; so when you load your telephone directory again you will not have to re-enter the LET statements. A word of warning though—the RUN command clears the values of all the variables. If you accidentally enter RUN, you will have to re-enter all the LET statements or LOAD the tape again.

The expression evaluator will also work with strings as well as with numbers, although we do not see a use for this feature at the moment. Run the following program:

```
10 INPUT A$
20 PRINT A$,CODE(A$)
30 GO TO 10
```

You will notice that the cursor appears on the screen between a pair of quotation marks(""). Enter the letter A. On the screen will appear the letter A and the number 38, which is the ZX80's internal numeric code for representing the character A. Now, using the RUBOUT and arrow keys, rubout the two quotation marks. You will notice that the familiar syntax error symbol appears. This is because the INPUT statement is looking for a string, and strings are delimited by quotation marks. If you enter "A" (including the quotation marks) you will see that it is accepted, because "A" is a valid string no matter whether you typed the quotation marks or whether the machine did it for you.

Certain internal functions of the ZX80 (those whose names end in $, such as CHR$), return strings as their outputs. As before, rubout the two quotation marks, but this time enter CHR$(38) (no quotation marks). Once again, the expression evaluator is used and evaluates the expression, returning the string "A" as its output. Since this is a valid string, it satisfies the INPUT statement and is accepted.

Now it is up to you to figure out a use for this feature of the ZX80. Send your discoveries to *SYNC*.

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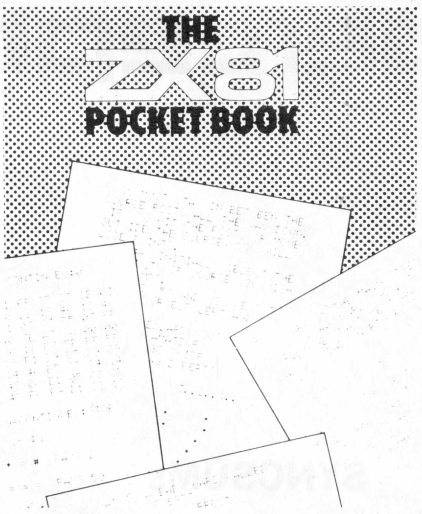

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perceptions

David Ornstein

SYNCSUMs

One day, I was typing a system-check program into our computer. I took four and a half hours to enter the program. As I was about to run it, an awful thought occurred to me: What if I had made an error in my typing? Since the program had access to all parts of the system, a typo could be fatal. I decided to check it against the listing . . . once. Then I ran it. The end result—that I overwrote the system disk—is irrelevant. But what is important is this: *If the program listing had included the program's SYNCSUM*, I would have known better.

What is a SYNCSUM? A SYNCSUM is what is known as a checksum, or, rather, a modified version of a checksum. The checksum is a method of checking to see whether a program has been entered correctly by letting the computer add up all the bytes in a program. To use this error-checking method, you simply compare the checksum of the original program with the checksum of the program you have entered. If the numbers are not the same, you have made an error in entering the program. If the numbers are the same, the chances are about 90% that you have entered the program correctly.

In the ZX81, a certain area of memory is used to hold the current program. This area begins where the area for the system variables ends. For the ZX81 it is 16509 decimal (407D hex). A system variable points to the first byte of the display file (i.e., the address of the last byte of the program plus one). This variable is stored at location 16396.

The assembly language program shown in Listing 1 is used to generate the current program's SYNCSUM on the ZX81 system. You will notice that is is not adding all the bytes, but XORing them together. This is the modification of the standard checksum method referred to earlier. You will end up with a number which is less than 256.

To use the SYNCSUM program on a Basic program requires that the SYNCSUM program be resident (i.e., in memory) all the time. This can be accomplished first, by reserving some memory (RAM) such that Basic will not tamper with it, and, second, by loading the SYNCSUM routine into this area. Listing 2 is a program to reserve the required amount of memory, 27 bytes. Listing 3 is the program to load the machine language SYNCSUM generation program into this previously reserved memory space.

These programs should be run at the beginning of any session of computer use when you may want to know a programs's SYNCSUM. From the time they are run until the computer is turned off, obtaining the SYNCSUM is simple: type

Label	Hex	Assembly Code	Comments
8KSSUM:	217D40	LD HL,16509	;HL=Start
	ED5BOC40	LD DE,(D-FILE)	;DE=Stop
	0600	LD B,00	;B=00 (Result Accumulator)
LOOP:	7C	LD A,H	;If HL≠DE then XORNXT
	BA	CP D	
	2008	JR NZ,XORNXT	
	7D	LD A,L	
	BB	CP E	
	2004	JR NZ,XORNXT	
DONE:			;else done
	48	LD C,B	;low byte returned is SYNCSUM
	0600	LD B,00	;high byte is 00
	C9	RET	
XORNXT:			;XOR the next byte into the ;Result Accumulator.
	78	LD A,B	;Get current RA
	AE	XOR (HL)	;XOR it in
	47	LD B,A	;put back result into RA
	23	INC HL	;bump pointer
	18EE	JR LOOP	;go back for next byte

Listing 1.

PRINT USR(x), where x = your memory size (for example, 1024, 2048, 16384) - 27 + 16384, followed by NEWLINE as always. Thus x will equal 17381 for 1K, 18405 for 2K, and 32741 for 16K.

Enter (or LOAD) the RSV program (Listing 2) and then RUN and NEWLINE. Next enter or LOAD the LDR program (Listing 3). Press RUN and NEWLINE. Hit NEWLINE and you will return to program mode. The SYNCSUM routine is now resident.

On a ZX81 system, type NEW and NEWLINE.

You can now begin entering *your* program. Once again, you can LOAD your program if you like. You can obtain the SYNCSUM at any point along the way via the PRINT USR (x) command (see above for the size of x). When you have finished and you are sure your program is correct, call for the SYNCSUM for the entire program. Write it down at the end of your program for future reference. Be sure to include it after the end of any programs submitted to *SYNC*.

I hope this idea is as helpful to ZX81 owners as it is to the rest of the computer world.

Until next issue, same relativistic time period, same non-euclidian universe.

```
10 LET R=27  [the number of bytes to reserve]
20 LET RAMTOP=PEEK(16388)+PEEK(16389)*256-R
30 POKE 16388,RAMTOP-256*INT(RAMTOP/256)
40 POKE 16389,INT(RAMTOP/256)
50 NEW
```

Listing 2: 8K ROM RSV.

```
10 REM 217040ED5B124006007CBA20087DBB
   2004680600C978AE472318EE
20 LET RT=PEEK(16388)+PEEK(16389)*256
30 FOR B=0 TO 26
40 LET X=((PEEK(16509+5+B*2)-28)*16+(PEEK
   (16509+5+B*2+1)-28))
50 POKE RT+B,X
60 NEXT B
```

Listing 3: 8K ROM LDR

8K ROM
1K RAM

How is it done?

An Introduction to Machine Code

Dr. Ian Logan

The managing editor and I are frequently asked about how one starts to use machine code on a ZX80/1. So this article is an attempt to reply to these questions, and I trust that you will find that machine code is not only for the expert.

An Outline View

The ZX80/1 microcomputer system as supplied by Sinclair Research is capable of being programmed in two different languages, i.e., Basic and Machine Code.

Basic is a very easy language to use for the beginner and, as long as one's programs are simple, the language is almost 'ideal.' However, Basic is a rather 'slow' language and limited in its commands.

Machine code, however, is a much more difficult language to use. The resultant programs are executed by the Z80 microprocessor at a fantastic speed and the complexity of the programs is limited more by the knowledge of the programmer than by the actual microcomputer.

It is always difficult to explain to the 'beginner' just how to write a machine code program, but in this article we will begin by drawing upon the similarities between Basic and machine code.

Program Structure

A Basic program is made up of a set of Basic lines. In the ZX80/1 system these lines are kept in an area of the RAM (random access memory) that is termed by Sinclair as the PROGRAM AREA. When the user first turns on the machine, this PROGRAM AREA is empty, and the user will then proceed to enter a program into this area. The program can be as short as a single line, e.g., 10 PRINT or can be several hundred Basic lines. The user will then RUN the program, and this will result in the system interpreting line after line of the program, as has been determined by the programmer, until the 'last' line has been reached.

Dr. Ian Logan, 24 Nurses Lane, Skellingthorpe, Lincoln LN6 OTT, United Kingdom.

A machine code program is in many ways dealt with in a similar manner. First, the programmer must decide just what part of the RAM he is going to designate as his 'machine code area.' It is possible in the ZX80/1 systems to choose an area from several different parts of the RAM but my favorite technique is to reserve part of the PROGRAM AREA by using a REM statement. The next task is to actually enter the machine code into the RAM and this has to be done by using POKE commands. An actual machine code program entered in this fashion can be made up of just a single instruction or many thousands of instructions. This program is then 'run' by using a USR command which is either a single line Basic program, e.g.,

10 LET A=USR(16427)

or a USR command occurring in a longer Basic program, in which case the machine code program becomes a 'machine code subroutine' of the Basic program. Note how the USR command has to be followed by a number. This number is the address of the location within the machine code area where the machine code program begins.

Instruction Format

All Basic lines can be described as containing an obligatory 'operator'—the command—and an optional 'operand.' The line

10 PRINT

contains only the 'operator' PRINT whereas the line

20 PRINT A

contains the 'operator' PRINT and the part that is to be printed, the 'operand' A. Note how the Basic line has the 'operator' coming before the 'operand.'

This division of a line into an 'operator' and an 'operand' is an essential part of Basic syntax and the ZX80/1 systems with their 'syntax checking' facility ensure that the user has no difficulty remembering to place his 'operators' before his 'operands.'

Just as it is in Basic so it is in machine code, but there are hundreds of different 'operators,' as opposed to the 20 or so in Basic.

Whereas a Basic program is made up of 'decimal numbers and letters,' a machine code program consists of only a set of numbers. These numbers can be considered to be in binary, decimal or hexadecimal arithmetic, but for users of the ZX80/1 systems the use of the decimal values is the easiest method, although the 'expert' will usually only think in hexadecimal arithmetic.

So what are the 'operators' in machine code? Well, they are the decimal numbers 0-255, (hex. OO-FF), but since more than 256 'operators' are required, the numbers 203, 221, 237, and 253 (hex. CB, DD, ED, and FD) introduce a second decimal number into the 'operators.'

In Basic the 'operators' are commonly called the 'commands' and in machine code the 'operators' are called the 'instructions.' Fortunately, one does not have to memorize all the different numbers as each instruction has been given a descriptive 'mnemonic' and most programmers only 'look-up' the numbers when they need them.

The 'operands' in machine code are also numbers in the range decimal 0-255, (hex. OO-FF), and these 'operands' are placed after the instructions proper when they are needed.

A machine code program may also

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contain 'data.' Once again this will be in the form of locations holding decimal numbers in the range 0-255.

All this is better illustrated by the example in Figures 1 and 2.

Note that the machine code subroutine would occupy 5 locations and would be entered by:

```
50 POKE 16514,62
52 POKE 16515,1
54 POKE 16516,198
56 POKE 16517,6
58 POKE 16518,201
```

and 'run' by using:

```
60 LET A=USR 16514
```

Note: Reserve locations 16514-16518 first.

Variables v. Registers

In a Basic program there are two different ways of handling variables. The first is to use 'named variables,' e.g., A,B,COUNTER, and this is very much the standard method. However, there is an alternate method that involves the use of ordinary memory locations to which the user will assign values as necessary. This second technique is commonly used in games that use the display file. E.g., if location 16800 is a 'certain point' on the screen, then 'POKE 16800,...' will assign the required value and 'PEEK 16800' will collect the value of the variable.

A machine code program normally uses this second method. That is, the programmer first selects certain locations that he wishes to be filled with 'named variables'; however, these 'names' are only known to the programmer and not the 'computer.'

It is possible though to take the general concept of the 'Basic named variables' a little further and draw a useful analogy between the use of certain Basic variables and the internal registers of the Z80 microprocessor.

In a Z80 microprocessor as used in the ZX80/1 there are many 'registers.' These registers can be considered as 'named variables' in an internal 'variable area.' Each is equivalent to an ordinary memory location in that it can hold a number which has the decimal range 0-255 (hex.OO-FF). The simple registers are the A, H, L, B, C, D, and E registers. The full set of registers is shown in Figure 2.

Although the registers are equivalent to 'one memory location,' there are many times when it is desirable to use a pair of registers that would thereby have the equivalent of 'two locations in memory.' The simplest register pairings are those of the H and L registers, the B and C registers and the D and E registers. Usually these are written as HL,DE, and BC. Such register pairs can be considered to be able to hold numbers in the range decimal 0-65535 (hex.OOOO-FFFF).

A Simple Basic Subroutine	**Comment**
10 LET Z=1	'operator' is 'LET Z', 'operand' is '1'
20 LET Z=Z+6	'operator' is 'LET Z', 'operand' is 'Z+6'
30 RETURN	'operator' is 'RETURN'.

Figure 1.

The Machine Code Subroutine			**Comment**
mnemonic	Decimal	Hex.	
LD A,+1	62 1	3E 01	Load the 'A' register with the constant 1.
ADD A,+6	198 6	C6 06	Add the constant 6 to the value in the 'A' register.
RET	201	C9	Return to the calling routine.

Figure 2.

The registers of the Z80 can therefore be considered as follows:

The A register is a variable named 'A'.

The H register is a variable named 'H'

and so on for all the simple registers named above. The register pairs can be considered as:

The HL register pair is a variable named 'HL'.

The BC register pair is a variable named 'BC'.

The DE register pair is a variable named 'DE'.

Actual Machine Code Instructions

Now that the analogy has been made, it is possible to use the variables A, H, L, B, C, D, E, HL, DE, and BC to explain the more simple of the 600+ instructions of the Z80 machine code language.

1) *Loading Constants.*

The simplest instructions are those that are used to load a register or a register pair with a 'constant.' For example, in the instruction 'LD A,+dd', the actual code would be two bytes. The first is a decimal 62, (hex.3E), and the second, the value of the constant itself. This instruction can

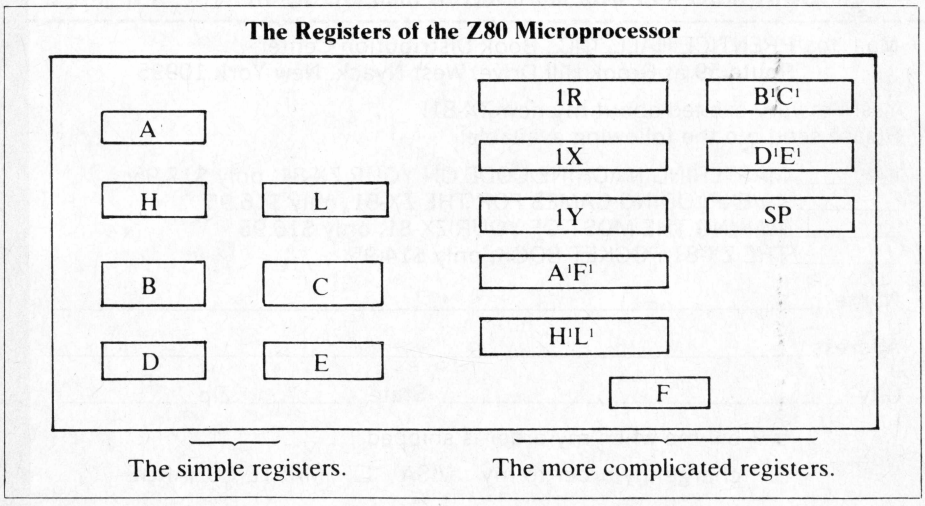

Figure 3.

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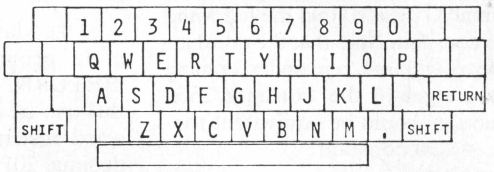

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be considered to have the same result as a Basic line:

LET A= ..... a constant,

when the variable A is located in the microprocessor. In the instruction 'LD HL,+dddd' the code is three bytes. The first is decimal 33 (hex.21) and the following two are the constant. Note that the constant always appears with the 'remainder' coming before the integer of the 'constant/256.' This instruction would be equivalent to:

LET HL = ... a constant.

or more precisely:

LET L = 'remainder' and

LET H = 'constant/256'

2) Loading Registers from memory Locations

There are only two simple instructions in this group. The first instruction is 'LD A,(addr.)' which is a three byte instruction. The first number is a decimal 58 (hex.3A) and whose other two bytes are the 'address in memory' of the location that is to be copied. Note that the address is once again to be entered as the 'remainder' followed by the 'address/256.'

The Basic equivalent of this instruction is:

LET A=PEEK(1st+2nd *256)

The other instruction is for loading the HL register pair, and the mnemonic is 'LD HL,(addr.).' Again, this is a three byte instruction. The first byte is decimal 42 (hex.2A), and the other two bytes are the address again.

The Basic equivalent is:

LET HL=PEEK(1st+2nd*256)+256* PEEK(1st+2nd*256)

or more simply:

LET L= PEEK(addr.)

and LET H=PEEK (addr.+1)

3) *Three Further Instructions*

It is beyond the scope of this article to detail more than just a few of the instructions in the Z80 machine code instruction set, but the following instructions will be used in the game below.

a) The contents of most registers can be copied into another register by using the appropriate instruction.

E.g., the instruction 'LD E,A' copies the contents of the A register into the E register. The instruction code is decimal 95 (hex.5F).

The Basic equivalent would be:

LET E=A

b) The contents of the DE register pair can be added to the contents of the HL register pair by using the instruction 'ADD HL,DE.' This instruction has the code decimal 25 (hex.19).

The Basic equivalent would be:

LET HL=HL+DE

or if preferred:

LET L=L+E

and LET H=H+D+ carry if present.

c) The last instruction of any machine code program must always act as a 'RETURN.' It is easy to understand that this can be performed by the straightforward instruction 'RET' whose code is decimal 201 (hex.C9), but it is often found that the 'return' is made by using a 'stack-handling' instruction instead.

The Basic equivalent of the 'RET' instruction is simply:

RETURN

Once the reader has understood just how instructions are used, it is fairly easy to gradually use the more complex instructions. Suitable lists and tables of all the instructions are to be found in all books on machine code programming, or if the reader prefers he can just take notes on 'new' instructions as he finds them in different programs.

The Demonstration Game

The following Basic program includes many features that can be easily 'machine coded.' However, as with many similar programs, there is no genuine advantage to replacing Basic lines with machine code subroutines, except from the point of interest.

If the reader wishes to try writing the whole of a 'Basic program' in machine code, then I very much suggest that he use a ZX80 with the 8K ROM and a 'slow converter,' or a ZX81, as machine code programming in 'slow' mode is the easiest for larger programs.

The Tower Game

There are two towers of 'bricks' and a single brick is taken from one tower and placed on the other tower. The choice of the 'declining' tower is made at random. The game is over when only a single tower remains.

A First Machine Code Subroutine

The easiest Basic line to convert to machine code is the line:

180 LET A=PEEK 16396+PEEK 16397*256

which picks up the address of the start of the Display File.

To convert this line then proceed as follows:

1) Replace line 180 by:

180 LET A=USR 16514

2) Enter a line 10:

10 REM 123456

that reserves 6 locations for the machine code. The starting address being 16514.

3) Enter:

POKE 16514,42 (hex. 2A)
POKE 16515,12 (hex. 0C)
POKE 16516,64 (hex. 40)
POKE 16517,68 (hex. 44)
POKE 16518,77 (hex. 4D)
POKE 16519,201 (hex. C9)

which will enter a 6-byte machine code routine into line 10.

4) RUN the program.

The 'mnemonics' for this program are:

LD HL,(D-File)
LD B,H
LD C,L
RET

where as before the address of D-File has to be split into '12' and '64'.

The Tower Game (8K ROM; 1K RAM) (SLOW Mode)

```
                                  Comment.
 20 RAND                          Different each time.
 30 DIM L(2)                      The two towers.
 40 LET L(1)=62                   The pointers to the tops of the
 50 LET L(2)=69                   towers in the Display File.
 60 FOR A=1 TO 4
 70 PRINT 9-A;"##############"    12 spaces.
 80 NEXT A
 90 FOR A=1 TO 4
100 PRINT 5-A;"####A######A"      4sp., graphic A, 6 sp., grap. A.
110 NEXT A
120 PRINT "###77777##77777"       3 sp., 5 grap. "7", 2 sp., 5 grap."7"
130 LET C=0                       Initialise the move counter.
160 LET R=INT (RND+1.5)           Randomly choose a tower.
170 LET P=1+(R=1)                 If R=1 then P=2, and vice versa.
180 LET A=PEEK 16396+PEEK 16397   Pick up the start of the D-File.
    *256
190 POKE A+L(R),0                 Remove a brick.
200 LET L(R)=L(R)+14              Point to "new" top of tower.
210 LET L(P)=L(P)-14              Point to space above the other tower.
220 POKE A+L(P),8                 Put the brick into place.
230 LET C=C+1                     Count the "move."
240 IF L(R)<118 THEN GOTO 140     If two towers exist, then go back.
250 PRINT "DID YOU GUESS#";C;"#   Did you do well?
    MOVES?"
```

A Second Machine Code Routine

If you have followed the article so far, you might now like to try a longer machine code routine. Several new instructions will be introduced.

In the *Tower Game* the start of the Display File is used as a base address to which the variables L(R) and L(P) are added in turn. The resultant address then points to the location that is to be filled with a specific value. All of this procedure can be easily performed in machine code.

The machine code routine is given in Figure 4.

```
16514 LD    HL,(D-File)  Pick-up D-File.
      LD    DE,dddd      The offset.
      ADD   HL,DE        Form new
                         address.
      LD    (HL),+00     Blank out this
                         location.
      RET                Finished.
16524 LD    HL,(D-File)  Pick-Up D-File.
      LD    DE,dddd      The offset.
      ADD   HL,DE        Form new
                         address.
      LD    (HL),+09     Put a 'brick' in
                         this location.
      RET                Finished.
```

Figure 4.

The instruction 'LD DE,+dddd' loads a 2-byte constant into the DE register pair. In the routine the first byte is altered as required whereas the second byte always stays as zero. The instruction 'LD (HL),+dd' is used to load a constant into the location whose address is the current value of the HL register pair.

Proceed now to make the changes in the program as follows:

1) Replace lines 10,180,190 and 220 by:

```
10 REM 12345678901234567890
180 POKE 16518,L(R)
190 LET A=USR 16514 or
190 RAND USR 16514 (which looks nice)
220 POKE 16528,L(P)
225 LET A=USR 16524 or
225 RAND USR 16524
```

2) Load line 10 by using:

```
500 FOR A=16514 TO 16533
510 INPUT B
520 POKE A,B
530 NEXT A
RUN 500
```

and enter:

42,12,64,17,0,0,25,54,0,201,42,12,64,17,0,0, 25,54,8,201.

3) Delete lines 500-530 and RUN the program.

The reader is now encouraged to try his own hand. For example, the variable C can be replaced entirely. This will, however, probably require the use the instructions in Figure 5.

A Bibliography

For those readers who wish to delve further into machine code, the following books are available (at least from U.K. suppliers).

Understanding Your ZX81 ROM by Ian Logan. £8.95. The Essential Software Company (Visconti Ltd.), 47, Brunswick Centre, London W1 CN 1AF, and other Melbourne House outlets. Need I say anything more than that this book deals extensively with the use of machine code in the ZX80/81 systems.

Mastering Machine Code on Your ZX81 or ZX80 by Tony Baker. £5.95. Interface, 44, Earls Court Road, London W8 6EJ. "Speak kindly of one's rivals and they will be kind to you."

Machine Language Programming for Your ZX80 & ZX81 £8.95. Melbourne House Publishers, 131, Trafalgar Rd., London SE 10.

The currently available books about the ZX81 are:

The ZX81 Campanion by Bob Maunder. $8.95 from Creative Computing Press, 39 East Hanover Ave., Morris Plains, NJ 07950.

A very good book. Deals more with 'computing theory' and less with the monitor than its predecessor.

The ZX81 Pocket Book by Trevor Toms. £4.95. Phipps Associates, 3, Downs Avenue, Epsom, Surrey KT 18 5HQ.

From *Interface*:

Getting Acquainted with your ZX81 by Tim Hartnell. $8.95 from Creative Computing Press, 39 East Hanover Ave., Morris Plains, NJ 07950.

30 Amazing Games for the ZX81 by Alistair Gourlay. £3.95.

50 Rip-Roaring Games for the ZX80 and ZX81. £4.95.

Hints & Tips for the ZX81. £4.25. Hewson Consultants, 7, Grahame Close, Blewbury, Oxon. OX 11 9QE.

Not Only 30 Programs for the Sinclair ZX81. £6.95. Essential Software Company (Visconti Ltd.), 47, Brunswick Centre, London W1 CN 1AF, and other Melbourne House outlets.

Again I would welcome seeing any programs written as a consequence of this article.

		dec.	hex.	
LD	A,+dd	62	3E	= LET A= ....
LD	A,(addr.)	58	3A	= LET A=PEEK.....
LD	(addr.),A	50	32	= POKE ... , A
INC	A	60	3C	= LET A=A+1

Figure 5.

EMVEE SOFTWARE — ZX81/16K PROGRAM

MINI-GOLF

The Program accurately simulates the game of stroke play golf. You play over 9/18 holes against either another Player or the ZX81 itself. Regardless of the selected length of round, holes are randomly generated in sets of 5 x Par 3;2 x Par 4 & 2 x Par 5 per each 9 holes. You and your opponent select a Club for each shot from identical sets of Driver: 1 thro 9 Irons;Pitching Wedge & Putter, each of which has a predetermined "standard" yardage. The better a Player is performing to Par the less the deviation is likely to be between the "standard" yardage for a particular Club and the actual yardage achieved from its use; conversely the worse a Player is performing to Par, the greater the deviation is likely to be. You may also elect to play a "soft" shot thereby reducing the potential distance that will be achieved from the use of a Club. As an overall probability, the better your performance is likely to become as the holes progress.

The screen constantly displays a "score-card" for the current 9 holes being played (with carried-forward totals included for an inward 9 holes), which shows for each hole - the total length; the length to the front edge of the Green; Par for the hole. For holes already completed the display shows for each Player - number of strokes taken; relative performance to Par per hole; cumulative performance to Par so far. For the current hole being played the display shows for each Player - shots taken so far; remaining distance to the Pin (which on reaching the Green is automatically converted from yards to feet). If you have a ZX Printer, the option exists to obtain a print-out of the "score-card" at the end of the outward and/or inward halves.

Because of the cost, and other potential problems associated with posting Program Cassettes to overseas clients, the Program is supplied in the form of a Program Listing (produced by a ZX Printer) from which you merely have to key-in the BASIC instructions. The listing is available together with a fully detailed Instruction Booklet and details of other Program Products, for just $6.00 (inc airmail postage). Interested? then please post the coupon below:

. . . . . .

Please forward a copy of ZX81/16K "Mini-Golf" for which I enclose $6.00 (Please also enclose full postal address details).

EMVEE SOFTWARE,
10 Mythop Road, Lytham FY8 4JD, Lancs, England.

8K ROM
16K RAM

An Inventory System

Dr. Stephen A. Justham

Mass data storage is accomplished more efficiently by a disc system than by a cassette recorder. However, until such a system is available for the ZX80/1 computers, Sinclair owners will have to rely on the cassette system. This article offers a program for a modest inventory system based on the 8K ROM and 16K RAM.

For the sake of illustration, a "pantry" inventory is used, but the program can be adapted to any inventory you might want to use it for. The program will handle up to 150 separate items (Figure 1), but it can be easily modified for the individual user (lines 305, 307, 3044, and all the "B=1 TO 150" statements).

One begins by selecting choice 1, indicating the total number of items to be entered (Figure 2), and INPUTing the item name and quantity in response to prompts (Figures 3 and 4). Once an inventory list is entered, the user has several options.

The search routine accepts a string input (Figure 5) and searches the inventory to ascertain if the item is in the listing. After searching, the computer replies with either a report on the item it has located (Figure 6) or a statement indicating that the item is not in the inventory (Figure 7). A complete inventory listing is available with the third option. The program lists each entry by item number, name, and quantity (Figure 8). If the list is long, there is an option at the end of the program to re-check the listing.

New items are added to the inventory by the fourth option. The current inventory is listed and a prompt requests the new item name and quantity (Figure 9). When

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```
          ***************
       PANTRY INVENTORY-10
          ***************
THIS PROGRAM HANDLES 150 ITEMS
          ***************

DO YOU WANT TO:
  1)START A NEW INVENTORY LIST?
  2)SEARCH FOR AN ITEM?
  3)CHECK INVENTORY?
  4)ADD NEW ITEM TO LIST?
  5)CHANGE QUANTITY OF AN ITEM?
  6)DELETE AN ITEM?
  7)EXIT PROGRAM?

ENTER YOUR CHOICE,1-7.

1
```

Figure 1.

```
   START A NEW INVENTORY LIST
**********************************

HOW MANY ITEM ARE TO BE LISTED?

4
```

Figure 2.

```
ITEM
 NO.

  1 ITEM NAME?  PEAS
    HOW MANY?  9
  2 ITEM NAME?  SUGAR
    HOW MANY?  2
  3 ITEM NAME?  BEANS
    HOW MANY?  19
  4 ITEM NAME?  CREAMED CORN
    HOW MANY?

5
```

Figure 3.

```
IF "5/???" APPEARS IN THE LOWER
LEFT CORNER,TYPE"C"TO CONTINUE
LISTING

ITEM NO.   ITEM NAME       QUANT.

    1        PEAS             9
    2        SUGAR            2
    3        BEANS           19
    4        CREAMED CORN     5

END OF FILE.

TYPE "1" TO RE-DO THE INVENTORY
LIST, "2" TO RETURN TO START OF
PROGRAM.

2
```

Figure 4.

```
      SEARCH FOR AN ITEM
******************************

TYPE THE NAME OF THE ITEM YOU
ARE SEARCHING FOR IN THE PANTRY.

"SALT   "
```

Figure 5.

```
      SEARCH FOR AN ITEM
******************************

TYPE THE NAME OF THE ITEM YOU
ARE SEARCHING FOR IN THE PANTRY.

THERE ARE    19          UNITS OF

     BEANS

LOCATED IN THE PANTRY.

TYPE "1" TO SEARCH FOR ANOTHER
ITEM, "2" TO RETURN TO START OF
PROGRAM.

1
```

Figure 6.

```
    SEARCH FOR AN ITEM
******************************

TYPE THE NAME OF THE ITEM YOU
ARE SEARCHING FOR IN THE PANTRY.

NO SUCH ITEM HAS BEEN FOUND IN
THE INVENTORY.
TYPE "1" TO SEARCH FOR ANOTHER
ITEM, "2" TO RETURN TO START OF
PROGRAM.

1
```

Figure 7.

```
      INVENTORY LISTING
******************************

IF "5/???" APPEARS IN THE LOWER
LEFT CORNER,TYPE"C"TO CONTINUE
LISTING.

ITEM NO.   ITEM NAME       QUANT.

   1        PEAS             9
   2        SUGAR            2
   3        BEANS           19
   4        CREAMED CORN     5

END OF FILE.

TYPE"1"TO EXAMINE INVENTORY, "2"
TO RETURN TO START OF PROGRAM.

2
```

Figure 8.

```
    ADD ITEM TO INVENTORY
******************************

WHEN YOU WISH TO END NEW ENTRIES
TYPE "RETURN."

IF "5/???" APPEARS IN THE LOWER
LEFT CORNER,TYPE"C"TO CONTINUE
LISTING.

ITEM NO.   ITEM NAME       QUANT.

   1        PEAS             9
   2        SUGAR            2
   3        BEANS           19
   4        CREAMED CORN     5

ITEM NO. 5
   ITEM NAME?  SALT
   HOW MANY?

3
```

Figure 9.

```
    CHANGE QUANTITY OF AN ITEM
******************************

IF "5/???" APPEARS IN THE LOWER
LEFT CORNER,TYPE"C"TO CONTINUE
LISTING.

SELECT ITEM TO BE CHANGED BY
"ITEM NO."

ITEM NO.   ITEM NAME       QUANT.

   1        PEAS             9
   2        SUGAR            2
   3        BEANS           19
   4        CREAMED CORN     5
   5        SALT             3

END OF FILE.

SELECT ITEM TO BE CHANGED BY
"ITEM NO."

3
```

Figure 10.

```
ITEM NO. 4 IS CREAMED CORN
WHICH CURRENTLY CONTAINS 5
UNITS.

INPUT QUANTITY CHANGE.

USE A "MINUS"SIGN TO REDUCE THE
QUANTITY.

-2
```

Figure 11.

```
ITEM NO. 4,CREAMED CORN  *NOW
HAS 3 UNITS.

TYPE"1"TO CHANGE ANOTHER ITEM OR
"2" TO RETURN TO START OF PROGRAM
OR "3"TO REVIEW THIS LISTING.
```

Figure 12.

```
  DELETE AN ITEM FROM INVENTORY
******************************
EACH ITEM WILL APPEAR ONE AT A
TIME.

  1)IF YOU DO NOT WANT TO DELETE
THE ITEM TYPE "S."
  2)IF YOU WANT TO DELETE THE
ITEM TYPE "D."
  3)IF YOU WISH TO TERMINATE
"DELETE" TYPE "T."

**********
ITEM NAME
   PEAS          S
   SUGAR         D
   BEANS

"T  "
```

Figure 13.

```
YOU HAVE INDICATED YOU WISH TO
EXIT THIS PROGRAM.

IF YOU HAVE MADE ANY CHANGES

******************************
*DO NOT FORGET TO RE-LOAD TAPE*
******************************

TO SAVE THIS PROGRAM AS CHANGED
PREPARE THE TAPE RECORDER,BEGIN
RECORDING,AND TYPE "C."2

9/2020
```

Figure 14.

the addition of items is completed "RETURN" is typed to send the program back to the menu at the beginning of the program.

Since an inventory must always accommodate changes in the quantity of the items, the quantity change routine is very important. Option five, which first prints the complete inventory, asks for the item number of the item to be changed (Figure 10). After the item is selected, it is detailed and the change is requested (Figure 11). Finally, the item number, name, and quantity change are printed out. The user can then return to the start of the routine to change another item (Figure 12).

The last option, aside from exiting the program, permits the deletion of an item from the inventory list. An item is printed and the user inputs one of three choices: save, delete, or terminate the routine (Figure 13).

Exiting from the program and SAVEing the program are combined in the last option. The prompts remind the user to re-load the tape with the up-dated inventory list (Figure 14).

Several minor problems were encountered in attempting to develop a workable inventory-type program for the ZX80/1. Most notable of the "minor" problems involved the way the 8K ROM handles string arrays. This problem can to light when the "SEARCH" routine was first (and second, and third, and ...) attempted. Finally, the attempt to use a "SEARCH" routine was set aside. The solution to the problem, which involved INPUTing an "ITEM NAME," having the inventory checked by the computer and then reporting whether or not the item appears in the inventory came from a technique used in another part of the program, lines 1080-1084.

The difficulty involved in using the two-dimension array is in the second dimension. Once set (or simply using the 8K Basic ROM's own setting of 10 characters in length) the ZX80 only recognizes an item with the same number of second dimension characters. For example, if an array statement reads DIM (5,5), then five items, five characters in length may be input. If "PEAS" is typed in as an inventory item the computer will store it as "PEAS blank space." In the search routine one must

type "PEAS blank space" in order to find the item in the inventory. Typing "PEAS" will not be accepted as "PEAS blank space." Lines 3040-3068 overcome this problem, mainly through the LEN function used in conjunction with a string and the one-time use of a string array.

The "DELETE" routine also proved to be something of a programming challenge. Originally an item could be deleted, but the item number remained with a blank for the item name and an "O" for the quantity. An associated problem involved the fact that the items were not moved 1, 2,..., or n places (depending upon the number of items deleted), but were clipped from the end of the list. These cumulative difficulties were overcome by introducing several variables, lines 1610-1618, and then using them at appropriate places throughout the routine; notably lines 1820, 1840, and 1908. Other manipulations such as found in lines 1830, 1835, 1900, 1909, and 1920 were employed to achieve the desired deletion and renumbering results.

Many "frills" have been used in the program and may be easily eliminated if so desired. For instance, the asterisks and many PRINT statements may be removed without affecting the program. These frill lines are marked by an * in the program. The total number of items may also be reduced. (NOTE: be sure to keep the first dimension of the two-dimension arrays one more than the total number desired, otherwise problems may occur in the deletion routine if the total number of items possible is used.) In all cases, it has been assumed that the user will know when to hit NEW-LINE, therefore, this does not appear in any PRINT statement.

Other routines or data variables may also be added to the program. If location is important this variable may easily be included possibly as a string variable. More generally, this program may be readily adapted to any type of inventory situation. ■

Program Notes:

5,7 "PANTRY" may be changed to whatever inventory you want.

160 If a number other than 1-7 is typed, this sends the computer back to 90 to start over again.

305 Sets the first dimension of the two dimension array equal to one more than necessary for the "DELETE" routine to function properly. The second dimension may be changed to meet individual needs.

332 Starts a loop that continues until told to leave—line 390—or the maximum "B"—150—is reached.

370 "X" equated to "B" in order to
375 evaluate "N" without involving "B" directly.

400 This and similar lines may be removed if the prompt is not needed.

490 Any INPUT other than "P" starts the program over.

960 These are necessary in order to
965 increase the number of items INPUT at the start of the program in line 310.

1040 Increases "B" by one each time a new item is INPUT.

1080 C$ is used and handled in this
1081 manner; otherwise the ZX80/1 will
1082 not read the "RETURN" order in line 1084. This involves the way in which two dimension string arrays are handled.

1125 This line removes the "ITEM NO.," "ITEM NAME," and "QUANT." line on which "RETURN" is typed, otherwise "RETURN" shows up as an item in the program.

1370 Increases or decreases (if minus sign is used) the quantity of the item.

1610 Used to accommodate the mani-
1615 pulations employed later to handle
1618 the "DELETE" aspects of this routine.

1800 Removes the deleted item from the
1810 file then sets the quantity to 0.

1830 Increments "B" by one to continue
1835 printing of the file after an item has been deleted.

1900 Decrements "N" by one for each item deleted.

1908 Re-sets "B" equal to what it had been originally, for renumbering purposes following a deletion.

3040 Because of the manner in which
3042 the ZX80 handles two dimension
3044 string arrays the only way (at least
3048 to the author's knowledge) to
3052 initiate a search is to INPUT a simple string array—line 3040—equate the array to its numerical length—LEN in line 3042—set up a new two dimension array with a variable second dimension—"J" in line 3044—start a loop—line 3048—equate the new string to the item—line 3052—and compare the INPUT, C$, to M$(B) (which is the same as I$(B)). If C$ is the same as M$(B), then the computer jumps to line 3100 and reports that the item is in the inventory and tells how many units are present.

Listing:

```
    2 REM STEPHEN A. > JUSTHAM, .8-5-81
    5 REM "PANTRY INVENTORY-10"
   *6 PRINT TAB 7;"***************
      "
    7 PRINT TAB 5;"PANTRY INVENTO
      RY-10"
   *9 PRINT TAB 7;"***************
      "
   10 PRINT "THIS PROGRAM HANDLES
      150 ITEMS"
  *11 PRINT TAB 7;"***************
      "
   15 PRINT
   20 PRINT "DO YOU WANT TO:",
  *25 PRINT
   30 PRINT TAB 2;"1)START A NEW
      INVENTORY LIST?"
   40 PRINT TAB 2;"2)SEARCH FOR A
      N ITEM?"
   65 PRINT TAB 2;"3)CHECK INVENT
      ORY?"
   70 PRINT TAB 2;"4)ADD NEW ITEM
      TO LIST?"
   75 PRINT TAB 2;"5)CHANGE QUANT
      ITY OF AN ITEM?"
   80 PRINT TAB 2;"6)DELETE AN IT
      EM?"
   86 PRINT TAB 2;"7)EXIT PROGRAM
      ?"
  *90 PRINT
   92 PRINT "ENTER YOUR CHOICE,1-
      7."
   96 INPUT A
   99 CLS
 *100 IF A=1 THEN GOTO 300
  110 IF A=2 THEN GOTO 3000
  120 IF A=3 THEN GOTO 600
  130 IF A=4 THEN GOTO 900
  140 IF A=5 THEN GOTO 1200
  150 IF A=6 THEN GOTO 1500
  155 IF A=7 THEN GOTO 2000
  160 GOTO 90
  300 PRINT TAB 3;"START A NEW IN
      VENTORY LIST"
 *301 PRINT "**********************
      ************"
  302 PRINT
  304 PRINT "HOW MANY ITEMS ARE T
      O BE LISTED?"
  305 DIM I$(151,15)
  307 DIM Q(151)
  310 INPUT N
  315 CLS
  322 PRINT
  324 PRINT "ITEM"
  326 PRINT TAB 1;"NO."
  328 PRINT
  332 FOR B=1 TO 150
  334 PRINT TAB 2;B;"#";
  340 PRINT "ITEM NAME?",
  350 INPUT I$(B)
  355 PRINT I$(B)
  360 PRINT TAB 5;"HOW MANY?",
  365 INPUT Q(B)
  368 PRINT Q(B)
  370 LET X=B
  375 IF X=N THEN GOTO 390
  380 NEXT B
  390 CLS
  400 PRINT "IF ""5/???"" APPEARS
      IN THE LOWER LEFT CORNER TY
      PE""C"" TO CONTINUE LISTING."
      [Note: "" is on shift Q]
  402 PRINT
  410 PRINT "ITEM NO.";TAB 10;"IT
      EM NAME"; TAB 24;"QUANT."
  420 FOR B=1 TO 150
  430 PRINT TAB 3;B; TAB 11;I$(B)
      ; TAB 26;Q(B)
  440 LET X=B
  455 IF X=N THEN GOTO 470
  460 NEXT B
```

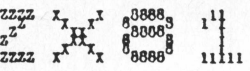
```
 470 PRINT
 471 PRINT "END OF FILE."
 472 PRINT
 475 PRINT "TYPE ""1"" TO RE-DO
     THE INVENTORY LIST, ""2"" TO
     RETURN TO START OF PROGRAM."
 480 INPUT P
 482 CLS
 485 IF P=1 THEN GOTO 300
 490 IF P<>1 THEN GOTO 6
 600 PRINT TAB 7;"INVENTORY LIST
     ING"
*601 PRINT "**********************
     ************"
 602 PRINT
 603 PRINT"IF ""5/??"" APPEARS
     IN THE LOWER LEFT CORNER
     TYPE""C""TO CONTINUE##
     LISTING."
 605 PRINT
 610 PRINT "ITEM NO."; TAB 10;"I
     TEM NAME"; TAB 24;"QUANT."
 615 PRINT
 620 FO B=1 TO 150
 622 LET X=B
 630 PRINT TAB 3;B; TAB 11;I$(B)
     ; TAB 26;Q(B)
 635 IF X<>N THEN GOTO 645
 638 PRINT
 640 PRINT "END OF FILE."
 641 GOTO 650
 645 NEXT B
 650 PRINT
 660 PRINT "TYPE""1""TO EXAMINE
     INVENTORY, ""2""TO RETURN TO
     START OF PROGRAM."
 670 INPUT D
 672 CLS
 680 IF D=1 THEN GOTO 600
 690 IF D<>1 THEN GOTO 6
 900 PRINT TAB 6;"ADD ITEM TO IN
     VENTORY"
*901 PRINT "**********************
     ************"
 902 PRINT
 906 PRINT "WHEN YOU WISH TO END
     NEW ENTRIESTYPE ""RETURN."""
 910 PRINT
 920 PRINT "IF ""5/???"" APPEARS
     IN THE LOWER LEFT CORNER TYP
     ""C"" TO CONTINUE##LISTING."
 925 PRINT
 930 PRINT "ITEM NO."; TAB 10;"I
     TEM NAME"; TAB 24;"QUANT."
 935 PRINT
 940 FOR B=1 TO 150
 950 PRINT TAB 3;B; TAB 11;I$(B)
     ; TAB 26;Q(B)
 960 LET X=B
 965 LET G=N
 970 IF B=150 THEN GOTO 1000
 980 IF X=N THEN GOTO 1040
 990 NEXT B
1000 PRINT "SORRY,FILE IS FULL."
1010 PRINT "TYPE ""C"" TO RETURN
     TO START OF PROGRAM."
1020 STOP
1030 GOTO 6
1040 LET B=B+1
1045 LET N=B
1048 IF G=B THEN GOTO 1000
1050 PRINT
1060 PRINT "ITEM NO.";B
1070 PRINT TAB 3;"ITEM NAME? ";
1080 INPUT C$
1081 PRINT C$
1082 LET I$(B)=C$
1084 IF C$="RETURN" THEN GOTO 11
     20
1090 PRINT TAB 3;"HOW MANY? ";
1100 INPUT Q(B)
1105 CLS
1100 GOTO 1040
1120 CLS
1125 LET N=B-1
1130 GOTO 6
1200 PRINT TAB 3;"CHANGE QUANTIT
     Y OF AN ITEM"
*1202 PRINT "**********************
     ***************"
 1210 PRINT
 1212 PRINT "IF ""5/???"" APPEARS
     IN THE LOWER LEFT CORNER TYPE
     ""C"" TO CONTINUE LISTING."
 1214 PRINT
 1220 PRINT "SELECT ITEM TO BE CH
     ANGED BY ""ITEM NO."""
 1222 PRINT
 1230 PRINT "ITEM NO."; TAB 10;"I
     TEM NAME"; TAB 24;"QUANT."
 1235 PRINT
 1240 FOR B=1 TO 150
 1260 LET X=B
 1270 PRINT TAB 3;B; TAB 11;I$(B)
     ; TAB 26;Q(B)
 1280 IF X<>N THEN GOTO 1300
 1285 PRINT
 1290 PRINT "END OF FILE."
 1292 GOTO 1310
 1300 NEXT B
 1310 PRINT
 1320 PRINT "SELECT ITEM TO BE CH
     ANGED BY ""ITEM NO."""
 1330 INPUT B
 1335 CLS
*1340 PRINT "ITEM NO.#";B;"#IS#";
     I$(B);"#WHICH CURRENTLY
     CONTAINS #";Q(B);"###UNITS."
*1342 PRINT
 1350 PRINT "INPUT QUANTITY CHANG
     E."
 1351 PRINT
*1352 PRINT "USE A ""MINUS""SIGN
     TO REDUCE THE QUANTITY."
 1360 INPUT K
 1362 CLS
 1370 LET Q(B)=Q(B)+K
*1380 PRINT "ITEM NO.#";B;",#";I$
     (B);",";"NOW HAS#";Q(B);"#U
     NITS."
*1382 PRINT
 1390 PRINT "TYPE""1""TO CHANGE A
     NOTHER ITEM OR""2""TO RETUR
     N TO START OF PROGRAM OR ""
     3"" TO REVIEW THIS LISTING."
 1400 INPUT R
 1405 CLS
 1410 IF R=1 THEN GOTO 1320
 1420 IF R=2 THEN GOTO 6
 1425 IF R=3 THEN GOTO 1200
 1500 PRINT TAB 2;"DELETE AN ITEM
     FROM INVENTORY"
*1501 PRINT "**********************
     ***********
 1510 PRINT
 1520 PRINT "EACH ITEM WILL APPEA
     R ONE AT A TIME.""
 1530 PRINT
 1540 PRINT TAB 2;"1) IF YOU DO NO
     T WANT TO DELETE THE ITEM
     TYPE""S."""
 1545 PRINT
 1550 PRINT TAB 2;"2)IF YOU WANT
     TO DELETE THE ITEM TYPE ""
     D."""
 1555 PRINT
 1560 PRINT TAB 2;"3)IF YOU WISH
```

```
      TO TERMINATE ""DELETE"" TY
      PE ""T."""
 1562 PRINT
*1565 PRINT "**********"
*1567 PRINT
*1570 PRINT "ITEM NAME"
*1575 PRINT
 1580 LET X=1
 1590 FOR B=X TO 150
 1600 IF I$(B)="" THEN GOTO 1710
 1610 LET Y=B
 1615 LET X=B
 1618 LET Z=N
 1620 PRINT TAB 3;I$(B);"#";
 1630 INPUT Z$
 1635 PRINT Z$
 1640 IF Z$="S" THEN GOTO 1710
 1650 IF Z$="D" THEN GOTO 1800
 1660 IF Z$="T" THEN GOTO 1675
 1665 CLS
 1670 GOTO 1520
 1675 CLS
 1680 GOTO 6
 1710 IF B=N THEN GOTO 1730
 1720 NEXT B
 1725 PRINT
 1730 PRINT
 1735 PRINT "END OF FILE."
 1740 PRINT
 1750 PRINT "TYPE ""1"" IF YOU WI
      SH TO DELETE OTHER ITEMS,TY
      PE ""2 "" TO RETURN TO
      START OF PROGRAM."
 1760 INPUT W
 1765 CLS
 1770 IF W=1 THEN GOTO 1500
 1780 IF W<>1 THEN GOTO 6
 1800 LET I$(B)=""
 1810 LET Q(B)=0
 1815 IF N=B THEN GOTO 1920
 1820 FOR B=Y TO 150
 1830 LET I$(B)=I$(B+1)
 1835 LET Q(B)=Q(B+1)
 1840 IF Z=B THEN GOTO 1900
 1850 NEXT B
 1900 LET N=N-1
 1908 LET B=X
 1909 IF N=B THEN GOTO 1730
 1910 GOTO 1590
 1920 LET N=N-1
 1930 GOTO 1730
 2000 PRINT "YOU HAVE INDICATED Y
      OU WISH TO##EXIT THIS PROGR
      AM."
*2005 PRINT
 2010 PRINT "IF YOU HAVE MADE ANY
      CHANGES"
*2012 PRINT
*2013 PRINT "**********
      *********"
 2015 PRINT "*DO NOT FORGET TO RE
      -LOAD TAPE*"
*2016 PRINT "**********
      ***********"
*2017 PRINT
 2018 PRINT "TO SAVE THIS PROGRAM
      AS CHANGED PREPARE THE TAPE
      RECORDER, BEGIN RECORDING,
      AND TYPE ""C."""
 2020 STOP
 2030 SAVE "PANTRY INVENTORY-10"
 2040 GOTO 6
 3000 PRINT TAB 7;"SEARCH FOR AN
      ITEM"
*3010 PRINT "**********
      **********"
 3020 PRINT
 3030 PRINT "TYPE THE NAME OF THE
      ITEM YOU##ARE SEARCHING FOR
      IN THE PANTRY."
 3040 INPUT C$
 3042 LET J=LEN C$
 3044 DIM M$(151,J)
 3048 FOR B=1 TO 150
 3052 LET M$(B)=I$(B)
 3068 IF C$=M$(B) THEN GOTO 3100
 3070 NEXT B
 3075 PRINT
 3080 PRINT "NO SUCH ITEM HAS BEE
      N FOUND IN##THE INVENTORY."
 3090 GOTO 3120
*3100 PRINT
*3102 PRINT
*3104 PRINT
 3110 PRINT "THERE ARE#";Q(B);"#
      UNITS OF"
*3114 PRINT
 3115 PRINT TAB 5;C$
*3119 PRINT "LOCATED IN THE PANTR
      Y"
*3120 PRINT
*3122 PRINT
*3124 PRINT
 3130 PRINT "TYPE ""1"" TO SEARCH
      FOR ANOTHER ITEM, ""2"" TO
      RETURN TO START OF PROGRAM."
 3140 INPUT U
 3145 CLS
 3150 IF U=1 THEN GOTO 3000
 3160 IF U<>1 THEN GOTO 6
```

Bridge Software

Quality Software

FOR THE



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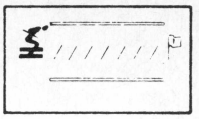

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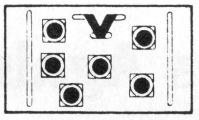

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Nine Defenders Against the Aliens

Martin Wren-Hilton

SYNC

SOFTWARE PROFILE

Name: Defender (Version 1.81)

Type: Arcade Space Fantasy

System: Sinclair ZX81, XZ80 (both 8K and 4K ROMs) (UK television, 625 lines only, at the moment)

Format: Cassette

Language: Z80 machine code

Summary: Better than any other arcade game I've seen.

Price: £5.50

Manufacturer:
Quicksilva
95 Upper Brownhill Rd.
Maybush, Southampton, Hants.
United Kingdom

I was absolutely amazed when I saw the *Defender* program for the first time. Written entirely in machine code, this program is better than any other arcade game I've seen.

After loading the game from the cassette, I glanced through the instruction sheet. This sheet tells the player which buttons to press ("6" to move down, "7" to move up, "9" to thrust forward and "0" to fire) and which addresses to POKE to alter the horizontal and vertical hold of the picture.

Entering RUN, the screen goes blank for three seconds, then the display appears: at the top of the screen is the number of Defender spaceships you have and your score, at the bottom of the screen three lines of 'moving scenery' give the effect of movement, and on the left hand side of the screen is your spaceship. It should be noted that this program only works on UK 625 line television at the moment, although the author is working on an American 525 line television version. This is because the screen display occupies the whole of the television screen from the very top right to the very bottom.

After a short period of time the aliens appear from the right. The aim of the game is to blast them to pieces without getting blown up yourself. You start with 9 Defender spaceships and lose one when you get hit. The aliens fire from right to left and can have up to six missiles on the screen at once. You get 100 points for each alien. As the game progresses, more and more aliens appear on the screen up to a hectic maximum of 8 aliens, each firing six missiles at you. Your Defender spaceship can have up to six missiles on the screen at once.

The general movement of the aliens is from right to left, and up or down depending upon the type of alien. Unlike the original arcade *Defender* by Williams, there are no Humanoids, Smart Bombs, Baiters, Bombers, Mutants, Pods or Attack Waves nor are there 'Reverse' or 'Hyperspace' buttons. There is no provision for high scores either.

Having said that, if you happen to have the Quicksilva Sound Board, this program generates some fantastic sound effects for phasers and missiles, and every time you hit an alien a brilliant sound effect is produced.

Defender is available for 4K ROM machines with UK 625 line television as well as this version for 8K ROM machines.

Defender is a difficult and highly entertaining game that completely fills the screen and produces brilliant sound effects. This program is highly recommended and will keep you and your friends entertained for many, many hours.

The "QS Sound Board" For The ZX80/81

Play tunes in three-part harmony on your ZX80 or ZX81! Based on the extremely versatile AY-3-8910 sound generator chip, the QS Sound Board features complete software control of the frequency and amplitude of three independent output channels as well as an envelope shaper and noise channel.

The QS Sound Board can produce fairly accurate scales over a 5 octave range, from C at 32.7Hz to B at 989Hz with a minimal error of +/-0.5%. Because of the limitations of the power supply, no amplifier or speaker has been fitted to the QS Sound Board. Instead, the three channels have been mixed together and taken to a 3.5mm jack socket via a preset volume control, therefore an external amplifier and speaker are needed. The Radio Shack 277-1008 is recommended.

If you wish to use more than the onboard memory with the QS Sound Board, you will need the QS Motherboard which allows the 16K RAM pack to be used in conjunction with the QS Sound Board and one other board.

The QS Sound Board also features two 8 bit input/output ports taken to a 16 pin i/c socket for easy connection to external control functions via ribbon cable.

The prices for the above products are:

QS Sound Board £28.00
QS Motherboard £13.00
QS Sound Board & Motherboard £38.00

Quicksilva are at 95 Upper Brownhill Road, Maybush, Southampton, Hants., England.

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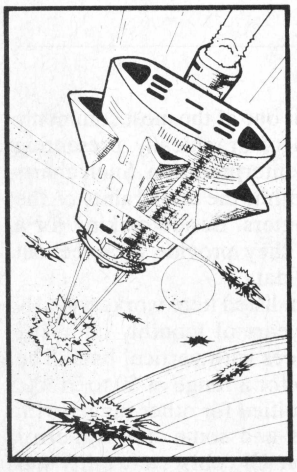

QS DEFENDER.
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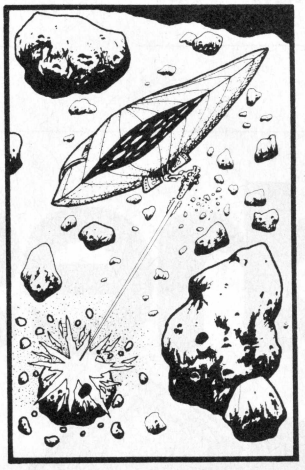
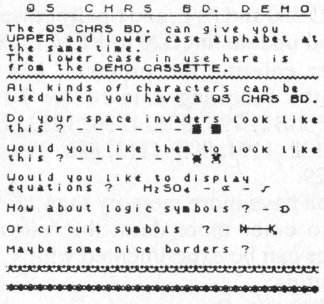


QS ASTEROIDS
Quicksilva's new arcade game. LEFT - RIGHT - THRUST - FIRE Software to drive QS SOUND BD. Multiple missiles firing in 8 directions. On screen scoring. Increasing number of asteroids. Full mobility of ship to all areas of the screen. Two asteroid sizes. Bonus ship at 10,000 points. Requires 8K ROM, 4K min of RAM + SLOW function.

QS CHRS BD./
A programmable character generator giving—128 SEPARATELY PROGRAMMABLE CHARACTERS. ON/OFF SWITCH. 1K ON BOARD RAM. Enables creation and display of your own characters to screen or printer. Demo cassette of fast machine code opeation routines and lower case alphabet included. See below for ZX PRINTER listing.



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A Hi-res graphics board giving—256 x 192 PIXELS. 6K ON BD. RAM. SOFTWARE SELECT/DESELECT. MIXED TEXT AND GRAPHICS. 2K ON BOARD ROM. Resident fast machine code graphics software (in ROM) provides the following HI-RES Commands.—MOVE x,y; PLOT x,y; DRAW x,y; PRINT X$; COPY; BLACK; WHITE; CLEAR. See side for ZX PRINTER listings using COPY.

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A programmable sound effects board using the AY-3-8910. 3 TONES; 1 NOISE; ENVELOPE SHAPER: + TWO 8 BIT I/O PORTS. Easily programmable from BASIC, the AY chip does most of the work leaving your computer free for other things. Signal O/P via 3.5 mm Jack socket Ports O/P via a 16 pin I.C. Socket.

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8K ROM
1K RAM

Setting Up Bar Charts

Jon Passler

```
 10 DIM B(20)
 20 FOR I=1 TO 20
 30 PRINT I;"    ";
 40 INPUT B(I)
 50 PRINT B(I)
 60 IF NOT B(I) THEN STOP
100 NEXT I
```

Subroutine

```
110 FOR I=15 TO 0 STEP -1
120 PRINT AT ABS I-15,I<10;I;"-
";
130 FOR J=1 TO 20
140 IF NOT B(J) THEN GOTO 200
150 LET D=B(J)+-I*100
160 IF D<-25 THEN PRINT " ";
170 IF D>-26 AND D<25 THEN PRIN
T " ";
180 IF D>24 THEN PRINT "■";
190 NEXT J
200 PRINT
210 NEXT I
320 REM B(17)
```

Bar Chart Program

A bar chart is one of the most commonly used methods of graphically presenting data for quick interpretation. Such charts work nicely within the constraints of the Sinclair computers. Beside making for a good display, they provide an excellent way of storing data.

The program listed here works with 1K to chart two years of monthly checking account balances with vertical bars. The graph is set up for a range of $0 to $1500, but can be modified for other ranges with a few changes and some trial-and-error experimentation. Of course, any other sort of data such as monthly rainfall or average temperatures, miles-per-gallon, electricity use, or frequency distributions (histograms) can be plotted.

Because of memory limitations the array storing the data is created and filled in a routine that is later erased (lines 10-100). All elements of the array contain either data or zeroes, and line 320 is used to show the user which element of the array should be filled next. To add a monthly figure enter 330 LET B(17)=XXXX, then GO TO 330 and N/L, and finally erase line 330 and update line 320 to REM B(18).

After entering the program, you can enter the following data to see how it works: 1012, 796, 931, 1236, 1252, 1088, 786, 1132, 1194, 908, 1113, 896, 913, 849, 553, 429.

If you have more memory than 1K and want to enter more data, the following changes can be experimented with.

Subroutine:

10: Increase B

20: Change the 20 to the new figure for B.

25: SCROLL

Bar Chart Program:

130: Change the 20 to the new figure for B.

Notes:

170: graphic on 3

180: graphic on 8

Jon Passler, 344 Cabot St., Beverly, MA 01915.
Adapted for ZX81 by James Grosjean.

Using Key and Token Expressions

Richard W. McDaniel

While translating a TRS-80 program for the Sinclair, I crashed the system. I had already saved most of the program, so I loaded it again and proceeded to cut anywhere possible to save memory. When the program was as compact as I could get it, I ran it again. After a few inputs the program stopped. I quit for the day.

A couple of days later, I was writing directions for a game in a REM statement and accidentally pressed the shift key and the "/" key simultaneously. Instead of "/", "NOT" appeared! I experimented more with this new technique and discovered that keywords as well as tokens could be typed into program lines in full—spaces and all—with practically a single keystroke.

Richard W. McDaniel, Box 71, Glasgow, VA 24555.

This technique not only saves typing time, but, because a keyword or a token is usually stored as a single byte, it also saves memory. I went back to the program I had been translating and modified it with this technique. It ran perfectly.

Let us look at some examples of how the technique works.

The program line:

10 REM TO RUN, USE GOTO 100

written the ordinary way takes 24 bytes whereas with the above key and token technique it only takes 14 bytes, for a saving of 10 bytes. A line such as:

20 PRINT "ENTER YOUR NAME"

can be

20 PRINT "INPUT YOUR NAME"

for a saving of 4 bytes.

In a line like

30 LET Z$="JIM AND JOE"

you save 8 bytes by using the token "AND".

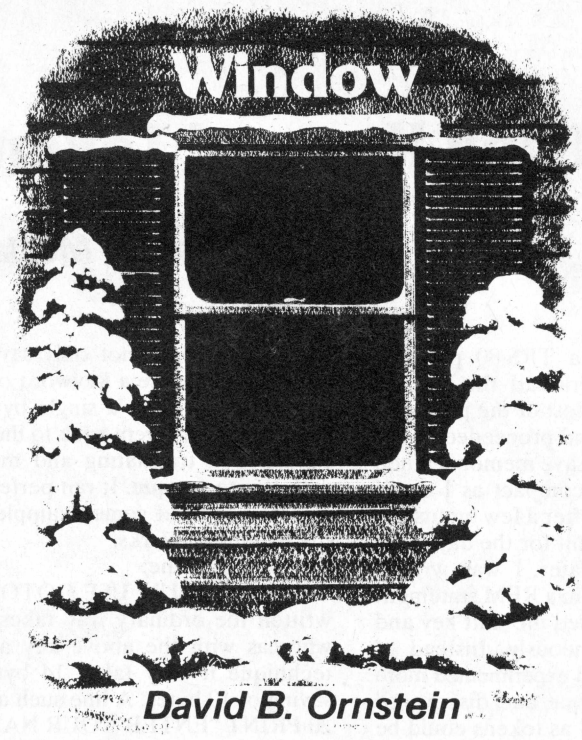
To use the technique in a line such as

100 PRINT "TO STOP PROGRAM, INPUT S"

type the statement number. Next type the last keyword first; then back up using shift "5" and enter the next to last keyword and so on until all keywords are entered. After that, type the keyword that uses the keyworded-characterstring either REM, PRINT or a characterstring, then type the tokens in their respective places. Finally, type any alphanumerics. The technique used in the above line saves 9 bytes.

If the keyword or token is preceded by another keyword or token, the preceding space of the following expression is omitted. If there is an alphanumeric between keywords or tokens, the spaces of each remain the same. I hope you find this technique as useful as I have.

8K ROM
16K RAM



Window

David B. Ornstein

Since the ZX81 uses the powerful Z80 microprocessor, it is a good system for which to write machine code programs. In the past months while writing many programs, I have found that there is one feature lacking on the system: a machine language monitor.

A machine language monitor is a utility, provided by most computer systems, which aids in the development of machine language programs. Its basic functions are: a) to allow you to view the contents of each byte in the system's memory, and b) to allow you to change these values.

The program provided here will allow you to perform these functions. It is a visual window into the system's memory, hence the name. In addition, it is a program which illustrates the programming litany: a program should contain very few constants intermixed with its code.

Looking at the program, you will see that the first few score of lines are all assignment statements (LETs). All arbitrary constants are specified in this section of the program. All references to these values later in the program are, then, symbolic, making the code easier to read.

Another benefit of coding the program this way is the ease of modification it provides. For example, you can change the line on the screen on which the 'window' begins by modifying the value of the variable PRITOP (PRImary screen TOP). Most of the visual arrangement can be changed by changing the value in one or two LET statements.

David B. Ornstein, 25 Shute Path, Newton, MA 02159.

```
   1 REM 12345678901234567890123..
.....
   2 REM       WINDOW

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         BY:
             HEURISTICS

         ANY COPY OF THIS
         PROGRAM, PRINTED
         OR MACHINE-READABLE,
         MUST INCLUDE THIS
         COPYRIGHT NOTICE.


   5 SLOW
  10 LET HEX16=2000
  12 LET DISP=1000
  14 LET SPLITBYTE=2100
  16 LET INVERSE=2200
  18 LET HEX8=2300
  20 LET GETKEY=2400
  22 LET C$="GKJD8PCO"
  24 LET INPUT=2500
  26 LET DEC16=2600
  28 LET AD=16514
  30 LET VALX=15
  32 LET CLRSEC=2700
  34 LET DEC8=2800
  36 LET CLRPMT=2900
  40 LET LPD=22
  42 LET PMTY=LPD-1
  44 LET PRITOP=1
  46 LET PRIBOT=5
  48 LET SECTOP=PRIBOT+1
  50 LET SECBOT=PMTY-1
  52 LET SECSIZ=SECBOT-SECTOP+1
  54 LET NUM=23
  56 LET FLY=PRITOP+(PRIBOT-PRIT
OP)/2
  58 LET FLV=6
  60 LET INVERT=128
  62 LET ADX=7
  64 LET MAXADDR=65535
  66 LET MINADDR=0
  68 LET FLX=30
  70 LET CURY=16442
  72 LET LPP=SECSIZ
  74 LET CHARX=20
  76 LET DL=SECSIZ
  78 LET MAIN=100
  80 LET MAIN2=130
  82 LET DISP2=1040
  84 LET DISP3=1080
 100 REM MAIN
 120 GOSUB DISP
 130 GOSUB GETKEY
 132 PRINT AT FLY,FLX;"■"
 135 IF Z=8 THEN GOTO 150
 137 IF Z>5 THEN LET Z=Z-1
 140 GOTO 3000+(Z-1)*1000
 150 FAST
 155 STOP
 157 SLOW
 160 GOTO MAIN
1000 REM DISPLAY
1010 FOR V=PRITOP TO PRIBOT
1020 PRINT AT V,0;"
"
1030 NEXT V
1040 PRINT AT FLY,1;"ADDR ";
1045 LET Z=AD
1050 GOSUB HEX16
1070 PRINT AT FLY,ADX;Z$;
1080 PRINT AT FLY,VALX;
1090 LET Z1=PEEK AD
1100 GOSUB HEX8
1110 PRINT Z$
1120 RETURN
2000 REM HEX16
2010 LET Z1=INT (Z/256)
2020 LET Z2=Z-Z1*256
2030 GOSUB SPLITBYTE
2040 LET Z$=CHR$ (Z8+NUM)+CHR$ (
Z9+NUM)
2050 LET Z1=Z2
2060 GOSUB SPLITBYTE
2070 LET Z$=Z$+CHR$ (Z8+NUM)+CHR
$ (Z9+NUM)
2080 RETURN
2100 REM SPLITBYTE
2110 LET Z8=INT (Z1/16)
2120 LET Z9=Z1-Z8*16
2130 RETURN
2200 REM INVERSE
2210 FOR Z=1 TO LEN Z$
2220 LET Z$(Z)=CHR$ (CODE Z$(Z)+
INVERT)
2230 NEXT Z
2240 RETURN
2300 REM HEX8
2310 GOSUB SPLITBYTE
2320 LET Z$=CHR$ (Z8+NUM)+CHR$ (
Z9+NUM)
2330 RETURN
2400 REM GETKEY
2405 LET CB=FLV
2410 LET Z$=INKEY$
2415 PRINT AT FLY,FLX;CHR$ CB;
2417 GOSUB 2470
2420 IF Z$="" THEN GOTO 2410
2430 FOR Z=1 TO LEN C$
2440 IF Z$=C$(Z) THEN RETURN
2450 NEXT Z
2460 GOTO 2410
2470 IF CB=FLV+INVERT THEN GOTO
2480
2475 LET CB=CB+INVERT
2480 RETURN
2490 LET CB=CB-INVERT
```

The commands for WINDOW are:

K- The K key (+) is used to move to the next memory location.

J- The J key (-) is used to move to the previous memory location.

G- The G key (GOTO) is used to move the current location to wherever you choose. The system will ask you for an address in hex.

P- The P key (PRINT) is used to list out the contents of 10 memory locations, in hex and as characters. The PRINT starts at the current location and, when done, sets the current location equal to the next location.

D- The D key (DISPLAY) is used to print out 5 lines of characters which are the characters in memory, from the current location on.

Q- The Q key (QUIT) is used to exit the WINDOW program. It will leave you in FAST mode. You can re-enter the program with CONTinue.

C- The C key (CALL) is used to call a machine language routine. Its address is specified by the current location address.

O- The O key (OPEN) is used to change the contents of the current location. The system will prompt you for a 2-digit hex value. The system will then increment the current location pointer. ■

Ed.—For those who do not want to do the work of entering the program, but who do want to enjoy its benefits, it can be obtained on cassette from Heuristics, 25 Shute Path, Newton, MA 02159 for $8.00.)

```
2495 RETURN
2500 REM INPUT
2510 INPUT Z$
2520 RETURN
2600 REM DEC16
2610 LET Z$="0000"(1 TO 4-LEN Z$
)+Z$
2620 LET Z=0
2630 FOR G=1 TO 4
2640 LET Z=Z*16
2650 LET Z=Z+CODE Z$(G)-NUM
2660 NEXT G
2670 RETURN
2700 REM CLRSEC
2710 FOR B=SECTOP TO SECBOT+1
2720 PRINT AT B,0;"
                    "
2730 NEXT B
2740 PRINT AT SECTOP,0;
2750 RETURN
2800 LET Z$="00"(1 TO 2-LEN Z$)+
Z$
2805 LET Z=16*CODE Z$+CODE Z$(2)
-476
2810 LET Z=(CODE Z$-NUM)*16+CODE
 Z$(2)-NUM
2820 RETURN
2900 REM CLRPMT
2905 PRINT AT PMTY,0;"
                      ";
2910 RETURN
3000 REM JUMP
3005 GOSUB 3200
3010 PRINT AT FLY+1,ADX;"    "
3015 PRINT AT PMTY,0;"ENTER THE
ADDRESS IN HEX."
3020 GOSUB INPUT
3025 GOSUB CLRPMT
3030 IF LEN Z$>4 THEN GOTO 3020
3040 GOSUB DEC16
3060 PRINT AT FLY+1,ADX;Z$
3070 FOR V=ADX TO ADX+3
3080 PRINT AT FLY+1,V;"■"
3090 PRINT AT FLY,V;Z$(V-ADX+1)
3100 NEXT V
3120 LET AD=Z
3130 GOSUB DISP3
3140 GOTO MAIN2
3200 LET Z=AD
3210 GOSUB HEX16
3220 GOSUB INVERSE
3230 PRINT AT FLY,ADX;Z$
3240 RETURN
4000 REM INC ADDR
4010 LET AD=AD+1
4020 IF AD>MAXADDR THEN LET AD=M
INADDR
4025 GOSUB 1040
4030 GOTO MAIN2
5000 REM DEC ADDR
5010 LET AD=AD-1
5020 IF AD<MINADDR THEN LET AD=M
AXADDR
5025 GOSUB DISP2
5030 GOTO MAIN2
6000 REM DISPLAY
6001 LET TC=AD
6003 GOSUB CLRSEC
6005 PRINT AT SECTOP,0;
6010 LET IL=LPD-PEEK CURY
6030 IF LPD-PEEK CURY>=DL+IL OR
INKEY$<>"" THEN GOTO MAIN2
6033 PRINT CHR$ (PEEK TC);
6035 LET TC=TC+1
6040 GOTO 6020
7000 REM PRINT
7005 GOSUB CLRSEC
7010 FOR P=0 TO LPP-1
7015 IF INKEY$<>"" THEN GOTO 130
7020 LET Z=AD+P
7030 GOSUB HEX16
7040 PRINT TAB ADX;Z$;TAB VALX;
7050 LET Z1=PEEK Z
7055 GOSUB HEX8
7060 PRINT Z$;TAB CHARX;CHR$ (Z1
)
7070 NEXT P
7080 LET AD=AD+P
7090 GOTO MAIN
8000 REM CALL
8005 GOSUB CLRSEC
8010 LET KK=USR AD
8020 PRINT AT SECTOP,0;"THE CALL
 SET BC=";
8030 LET Z=KK
8040 GOSUB HEX16
8050 PRINT Z$
8060 GOTO MAIN
9000 REM OPEN
9020 LET Z1=PEEK AD
9030 GOSUB HEX8
9040 GOSUB INVERSE
9060 FOR N=FLY+1 TO PRIBOT-1
9065 PRINT AT N,VALX;"  "
9070 PRINT AT N-1,VALX;Z$
9080 LET Z$="■■"
9095 NEXT N
9097 PRINT AT PMTY,0;"ENTER THE
VALUE IN HEX."
9100 GOSUB INPUT
9110 GOSUB CLRPMT
9120 IF LEN Z$>2 THEN GOTO 9100
9130 GOSUB DEC8
9140 PRINT AT PRIBOT-1,VALX;Z$
9150 FOR N=PRIBOT-1 TO FLY+1 STE
P -1
9160 PRINT AT N,VALX;"■■"
9170 PRINT AT N-1,VALX;Z$
9180 NEXT N
9190 POKE AD,Z
9195 LET AD=AD+1
9200 GOTO MAIN
```

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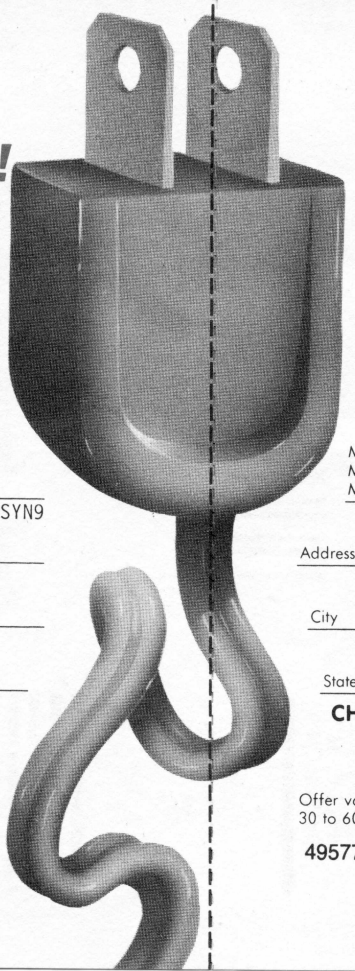

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Make the Most of Your ZX81 or 80

The ZX81 Companion

The ZX81 Companion by Bob Maunder follows the same format as the popular **ZX80 Companion**. The book assists ZX81 users in four application areas: graphics, information retrieval, education and games. The book includes scores of fully documented listings of short routines as well as complete programs. For the serious user, the book also includes a disassembled listing of the ZX81 ROM Monitor.

MUSE reviewed the book and said, "Bob Maunder's **ZX80 Companion** was rightly recognized to be one of the best books published on progressive use of Sinclair's first micro. This is likely to gain a similar reputation. In its 130 pages, his attempt to show meaningful uses of the machine is brilliantly successful."

"The book has four sections with the author exploring in turn interactive graphics (gaming), information retrieval, educational computing, and the ZX81 monitor. In each case the exploration is thoughtfully written, detailed, and illustrated with meaningful programs. The educational section is the same—Bob Maunder is a teacher—and here we find sensible ideas tips, warnings and programs too."

Softbound, 5 1/2 x 8", 132 pages, $8.95.

Getting Acquainted With Your ZX81

This book is aimed at helping the newcomer make most effective use of his ZX81. As you work your way through it, your program library will grow (more than 70 programs) along with your understanding of Basic.

The book is chock full of games such as *Checkers* which draws the entire board on the screen. Other games include Alien Imploders, Blastermind, Moon Lander, Breakout, Digital Clock, Roller-Ball, Derby Day, and Star Burst.

But the book is not all games. It describes the use of PLOT and UNPLOT SCROLL, arrays, TAB, PRINT AT, INKEYS, random numbers and PEEK and POKE. You'll find programs to print cascading sine waves, tables and graphs; to solve quadratic equations; to sort data; to compute interest and much more.

Softbound, 5 1/2 x 8", 120 pages $8.95.

The Gateway Guide to the ZX81 and ZX80

The Gateway Guide to the ZX81 and ZX80 by Mark Charlton contains more than 70 fully documented and explained programs for the ZX81 (or 8K ZX80). The book is a "doing book," rather than a reading one and the author encourages the reader to try things out as he goes. The book starts at a low level and assumes the ZX80 or ZX81 is the reader's first computer. However by the end, the reader will have become quite proficient.

The majority of programs in the books were written deliberately to make them easily convertible from machine to machine (ZX81, 4K ZX80 or 1K ZX80) so no matter which you have, you'll find many programs which you can run right away.

The book describes each function and statement in turn, illustrates it in a demonstration routine or program and then combines it with previously discussed material.

Softbound, 5 1/2 x 8", 172 pages, $8.95.

Computers For Kids, Sinclair Edition

Computers For Kids, by Sally Larsen is the fourth book in this highly successful series. (Previous editions have been released for TRS-80, Apple and Atari computers.) Written expressly for youngsters ages 8 to 13, the book requires no previous knowledge of algebra, variables or computers. Armed with a ZX81 and this book, a child will be able to write programs in less than an hour. A section is included for parents and teachers.

The book starts with a patient explanation of how to use the Sinclair, graduates to flow charts, and simple print programs. The twelve easy-to-read chapters go through loops, graphics and show other programming concepts, and show in a painless way how to make the computer do what you want.

Donald T. Piele, Professor of Mathematics at the University of Wisconsin-Parkside says, "**Computers For Kids** is the best material available for introducing students to their new computer. It is a perfect tool for teachers who are learning about computers and programming **with** their students. Highly recommended."

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